Some Serological Attributes of the European Gipsies

by

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ABSTRACT

This thesis describes some serological attributes of the European Gipsy populations in relation to the host countries and area of the postulated origin. Blood and serum group examinations were made on Czechoslovakian (Slovak) Gipsies. The methods used to determine the blood group types involved serological and electrophoretic techniques. The systems examined were: ABO, MNSs, Rh, Kell, Duffy, Kp, Haptoglobin, Transferrins, Acid Phosphatase, Adenylate Kinase, Phosphoglucomutase and Esterase D. A total of 119 Slovakian Gipsies were tested. In the different systems examined the phenotype and gene frequency values were calculated. Comparison of the present results with those of blood and serum group examinations performed on Northern-Indian populations and those of the Slovakian non-Gipsy populations show that the phenotype and gene frequency values of the Czechoslovakian (Slovak) among whom they live. Comparison of the present samples with published data for other European Gipsy populations, those of Northern India and those of European non-Gipsy populations revealed that there are still genetic differences between Gipsy populations and the surrounding communities, and suggests that present day Gipsy populations are increasingly diverging in genetic structure from each other and from the original ancestral population.

CONTENTS

To My Wife

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INTRODUCTION

i)

"I always remember about India. I have got an Indian heart because my ancestors came from India. I very much like to see India. I always dream to be in India. When I see an Indian man or woman going about in the town, my eyes follow him/her until he/she disappears from my sight, because I consider that he or she is part of my heart, of my blood".

From Roya, the famous Gipsy singer and once a member of the Gipsy theatre of Moscow and now living in Scandinavia (W R Rishi, 1974).

ii) GIPSIES

The Gipsies are a race of nomadic people inhabiting various countries and have customs, physical characteristics and languages which distinguish them from their hosts. No race, except perhaps the Jews, is so widely distributed over the world as are the Gipsies. Their settlements extend westwards from the Middle East, along the Mediterranean coasts of Europe and North Africa, throughout Europe and across to the Americas, and northwards to the USSR (Vesey-Fitzgerald, 1944).

They are believed to be the descendants of one or more Pariah tribes in central India and to have migrated into North India in the 7th and 8th Centuries AD. For some unknown reason they began to migrate westward before or about the turn of the present millennium (David MacRitchie, 1913).

When and why they left India is unknown. It is probable that groups left on several occasions and for different reasons.

The earliest reference to Gipsies accepted by Professor Bloch, the eminent authority on Gipsies, is by the Persian poet Ferdowsi who writes in his "Shah-Nameh" (1000 AD) that the King Bahram imported into Persia, from India, ten thousand itinerant minstrels of both sexes about the year 420 AD. At the end of the first year Bahram became angry with them and commanded that their asses and musical instruments should be taken away, and that they should roam the country and earn their livelihood by singing. This event was also described in 940 by the Arabian historian, Hamza. Ferdowsi called these people "Zott" which is the regular Arabic pronunciation of "Jatt" of the modern Syrian word for the Gipsies (C G Leland, 1874 and W R Rishi, 1974).

The author of the Persian work "Mudjmal at Twarikh" also emphatically says that the Gipsies, "Lulies, Korbati or Kali" of Modern Persia, are the descendants of these 10,000 musicians.

According to the chroniclers, in the seventh century, during a war between the Arabs and Persians, the Zott deserted from the Persian forces and settled in Arabia. According to Tabari, after the Byzantine conquest of Ainzarba (North Syria) in 855 AD, the Zott inhabitants were carried as prisoners into the Greek empire. They lived in Greece for a long time and then one branch went to the Baltic countries, while the rest spread into central and western Europe (Clebert, 1963 and McDowell, 1970).

Whatever the authenticity of these sources, it seems highly probable that the ancestors of the modern Gipsies left the banks of the Indus and went into Afghanistan and Persia during the first two centuries of the present millennium and settled in a broad zone extending from the North Caspian Sea to the Southern Persian Gulf. From here there were two principal migration routes; to the North the Gipsies spread across Armenia and the Caucasus, entering Russia, and to the South they followed the Tigris and Euphrates. Here a subsidiary group moved along the flank of the Mediterranean through Eastern Syria (where they gave rise to the present Syrian Kurbati), Palestine and Egypt and entered Spain via North Africa and the Straits of Gibraltar. A larger group spread through Turkey from where, after some time, they crossed the Bosphorus into the Balkan Peninsula and into Central Europe.

It is clear that the Gipsies spent much time in Persia and Greece before they spread to different parts of Europe. This is indicated by their language, since Greek and Persian words are found in all the

European Gipsy dialects including that in England.

It is likely, from the evidence of comparative linguistics, that the Gipsy languages separated from their related North-Indian tongues in about 1000 AD. In each country their speech has adapted itself to the language of the non-Gipsy inhabitants (Sher-Singh, 1966). In 1763 a Hungarian theological student, Stepan Valayi made acquaintance with three Indian students in Leiden (Holland), and in conversation with them discovered that their language had much in common with that of the Gipsies of his own part of Hungary. He drew up a vocabulary of one thousand words from the Indian students, and put it before the Gipsies of Roab (Hungary) and found that the Hungarian Gipsies were familiar with the majority of words on the list. This was an important language based anthropological discovery since it showed that the language of the Gipsies had some Sanskrit parentage (Fitzgerald, 1944). Subsequently Rudrigari (1773) and Grellman (1783), two German philologists, and Bryant, the British linguist, confirmed the linguistic relationship between Sanskrit and the Gipsies' dialects. This discovery was further corraborated by Pott in 1884 in his work "Die zigeuner in Europe und Asia" on the basis of the etymology of different Romanian dialects, the Sanskrit language and modern Indo-Aryan languages. Their relationship was further confirmed by Miller, Alexander Paspati, Miklosieh (1871) and Weislocki (1884), (Sher 1966). Franz von Miklosich, Professor at Vienna University in his important work "Uber die Munderfen und die Wanderungen der Zigeuner Europas" pointed out the precise place of origin of the Gipsies, among the Jats of Northern India, and the results of his research remain uncontested to this day (J Kochanowski, 1963).

The first English writer in this field was John Beams, who published in three volumes, "A Comparative Grammar of the modern Aryan language of India" in 1873, 1875 and 1879. Beams, an Indian Civil Servant, regarded the language of the European Gipsies as one of the Aryan languages of India (Singh, 1966).

Miklosich and Beams however emphasize that the Gipsies could not have left India before the evolution of the modern Aryan languages of India about 1000 AD, because their language has some similarity with the idiomatic form of certain Indian languages. This does not tie in with the historical evidence of the Gipsies' departure from India before 1000 AD.

According to B Vesey-Fitzgerald (1944), the Gipsies were settling in South-Eastern Europe in the fourteenth century or earlier but didn't arrive in central and Northern Europe until the fifteenth century. However, the Gipsies were in Corfu in the early fourteenth century, for the Empress Catherine de Valois (1301-46) granted to the Governor of Corfu authority to reduce to vassalage certain vagrants who came from the Greek mainland and used the Greek rites. By the end of the 14th century all these 'homines vaginiti' were the subjects of one Baron, Glanuli de Abitabula. If the Gipsies were present in Corfu, then the Italians must have come in contact with them earlier as mention of the Gipsies was made by a Venetian Viceroy, Othavanao Buono in about 1395 (B Vesey-Fitzgerald, 1944).

From 1417 there are many accounts of their spread into Europe, e.g. Rishi (1974), Sher Singh (1966), Clebert (1963). According to Winsted (1908) the Gipsies were present in central Europe prior to 1417. He has asserted that there were Gipsy settlements at Hidesheim in 1407, at Basle in 1414 and at Meissen in 1416. In the year 1417 they were seen

in Germany where, in order to safeguard themselves, they presented gifts to Bishops, Barons and Emperors and thus received letters of recommendation from them in order to enable them to move from one country to another. It is recorded that they presented themselves as penitents and pilgrims exiled from their homes to which effect they carried letters of recommendation from the Emperor Sigismund and also a letter from the Pope (V-Fitzgerald 1944, and Clebert 1963).

Albert Krantzius (Krantz), in his Saxonia says that "in the year 1417 there appeared for the first time in Germany a people uncouth, black, dirty, barbarous, called in Italian Giani, who indulged in thieving and cheating. They had among them a count and a few knights well dressed, and others followed afoot. The women and children travelled in carts. They also carried with them letters of safe conduct from the Emperor Sigismund and other Princes, and these letters helped them to be well received in the cities and towns where they professed that they were engaged on a pilgrimage of expiation for some act of apostasy. These people have no country and travel through the land. They live like dogs and have no religion although they allow themselves to be baptized in the Christian faith. They live without care and gather into themselves also other vagrants, men and women. Their old women practise fortune telling and whilst they are telling men of their fortunes they pick their pockets", (Encyclopaedia of Religion, 1913).

On the 17th of August 1427, 120 Gipsies were seen outside Paris, though it is probable that they were not allowed to enter the city. They appeared in Italy in 1422, they were in Barcelona by 1447 and gradually spread over Spain. They landed in England about 1440, though it is not clear how they came into England. They reached Yugoslavia by 1348. Many Gipsy tribes settled there, especially in the North near

the Hungarian border. They were in Hungary by 1415. Poland and Russia by 1500-1510, Scotland by 1490 or 1505 (Singh 1966, Clebert 1963). The Gipsies arrived in Sweden from Denmark, and gradually spread over the country in small bands. Norway and Finland got their Gipsies from Sweden. The Gipsies in the different Scandinavian countries have maintained close connections with one another, but from 1809, after the separation of Sweden and Finland, the Gipsies of the two countries have more and more been isolated from one another. According to Etzler the Gipsy population in Sweden was about 500 in 1943, those had the original Gipsy characteristics regarding appearance, behaviour and ways of living. At present the population number is about 900 (Beckman et al 1965).

According to Willy Guy (1963) after their first appearance in the Czech lands in 1399, a large group arrived from the east in 1417 or 1415. They spread rapidly over the entire country and were seen in Slovakia and Bohemia. In 1921 they were recognised as a nationality. By 1946 of a total Gipsy population of 101,190 there were 16,752 in the Czech lands. During the Second World War a number of them were killed by the Nazis, and after the war thousands of them left Slovakia for the Czech lands and settled in the industrial towns of North Bohemia and North Moravia. Also there was considerable re-migration to home settlements in Slovakia where conditions began to improve.

In 1968 about 226,468 Gipsies lived in Czechoslovakia and could be divided into different groups:

i Gipsies who lead a nomadic, wandering life.

ii Gipsies who live in more remote and separate colonies, in huts or primitive houses, some 50% belong to this group.

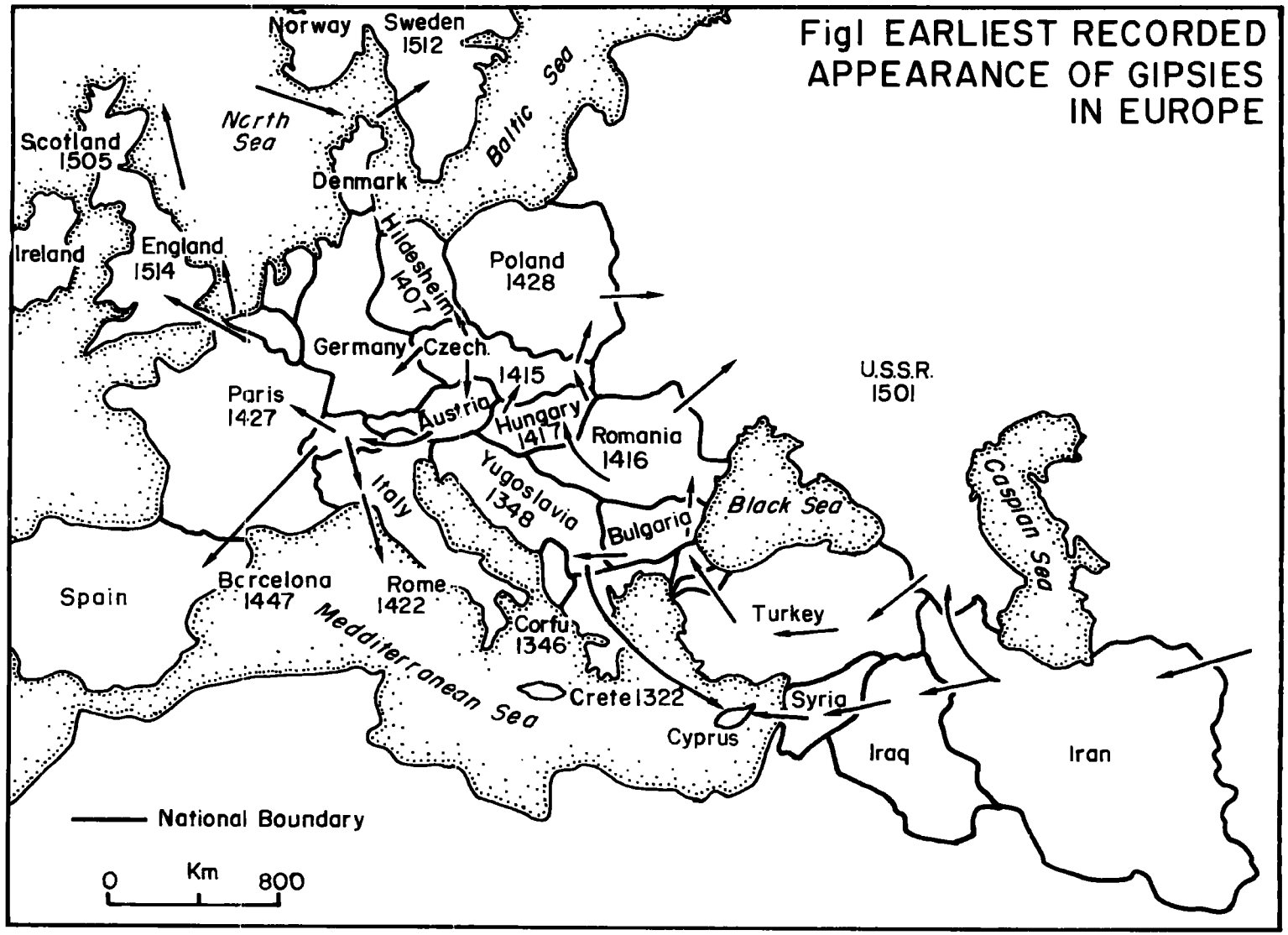


Fig1 EARLIEST RECORDED APPEARANCE OF GIPSIES IN EUROPE
Norway
Sweden 1512
North Sea
Baltic Sea
Scotland 1505
Denmark
Ireland
England 1514
Hildesheim 1407
Poland 1428
Germany
Czech. 1415
U.S.S.R. 1501
Paris 1427
Austria
Hungary 1417
Romania 1416
Yugoslavia 1348
Italy
Bulgaria
Black Sea
Caspian Sea
Spain
Barcelona 1447
Rome 1422
Corfu 1346
Turkey
Mediterranean Sea
Crete 1322
Syria
Cyprus
Iraq
Iran
National Boundary
0 Km 800

and iii Gipsies who live among the inhabitants and work regularly, and are being partly assimilated into the non-Gipsy population. (Horvathova, 1964).

Popular Names

The principal Gipsy names are traceable to one or other of two etymological roots. The appellation 'Czigany' in Hungary, 'Tzigan' in Bulgaria, 'Zigeuner' in Germany, 'Zingari' in Italy and 'Tinker' in England, all have the same stem. The second family of names stem from an Egyptian term of contempt: 'Gipsy' in England, 'Gitane' in Spain and 'Cyphtos' in modern Greek. Indeed the name "Egypt" itself comes from this root, for when the Gipsies first appeared in the West of Europe they claimed to have come from a country of their own called Little Egypt (Singh 1966).

Marriage

The centuries-old strict endogamy of European Gipsies is today breaking down with marriages between Gipsies and non-Gipsies becoming much more frequent. Marriage within clans used to be avoided and genealogies had to be traced and verified before proposed marriages could be sanctioned. Today however under the influence of Christian cultures this custom is being abandoned and there is relatively much more inbreeding. Consideration of ascendant and descendant relationships is also going into abeyance and now niece/uncle and aunt/nephew marriages are not infrequent. However, based on tradition, Gipsies still live in three different kinds of procreative unions: legitimate marriage, illegitimate union and concubinage. The offspring of matings between Gipsy and non-Gipsy are almost entirely socially regarded as Gipsy. Such matings are especially rare within the

unassimilated group. It is impossible to make even a very rough estimate of the rate of enogamy, because of the high percentage of illegitimacy.

Irish Tinkers are descended from early itinerant tradesmen and peasants who were forced from their lands by famines, war or poverty - many intermarried with Gipsies who arrived as migrants from India to Western Europe. As early as the fifth century, Smiths travelled the countryside, making personal ornaments and weapons in exchange for food and lodgings. By 1175, tinkers began to appear in written records. During the late 1950s and early 1960s many tinkers migrated to England as the economic opportunities were even greater in England than in Irish towns, for instance in the large industrial cities of Manchester and Birmingham. English welfare benefits, again, paid more than those in Ireland and attracted even more immigrants. (Clebert 1963, A M Fraser 1964/65).

Social Organisation

Though Gipsy laws of inheritance are very complicated, property is usually divided equally among all the children without any sexual discrimination and matrilineal clans can be seen to be more influential than patrilineal ones. Surprisingly, more attention has been paid by investigators to Gipsy men, chiefs and Kings than to women and Queens despite the fact that the women carry the principal burdens of supporting and maintaining the family. The greater importance of women can be observed in the contrast between the care with which a Queen's and a chief's successor is chosen. Chiefdom is simply a titular role. The title Gipsy chief is bestowed by Gipsies without much deliberation but the title of "Queen" is bestowed only after careful and due consideration is given to property and lineage. A prospective Queen,

as well as possessing considerable personal and family endowments, must be descended from a family of pure Gipsy blood. Gipsies readily assimilate the local religions. In Greece they belong to the Orthodox Greek faith; in Rumania they adhere to the national Church; in Hungary they tend to be Catholic and among Muslims they subscribe to Islam (Rishi 1974, MacRitchie 1913, Singh 1966).

Physical Characteristics

The most noticeable physical trait of the 'pure' Gipsies are their short stature, with mean heights of 161 cm to 164 cm; dark skin, and very dark eyes.

The Hungarian Gipsies are taller, with a mean of 166.5 cm. In France they can attain a stature of 166 cm, and be as tall as many Frenchmen. Coon (1954) believes that when the Gipsies arrived in Europe they were all or nearly all brown eyed. The head fair and the beard are almost black among pure Gipsies.

Many 'pure' Gipsies could pass as members of a small Mediterranean racial type but they could not have acquired these constant racial characteristics anywhere between the Indus and Hungary, since all Mediterranean forms encountered on the way are different. (Coon 1954, W Crooke 1973 and Encyclopaedia of Religion 1913).

iii) GENETIC VARIATION IN HUMAN POPULATIONS

The history of the divergence and evolution of the earlier primitive groups of man into today's complex components of race and creed is far from being fully explained or understood, but the discovery of differing blood groups by Landsteiner et al, in 1900-1901 heralded a new era of biochemical genetics and the number of biological markers for which population groups may be tested to determine possible affinity with others is being constantly increased.

We now recognise that the phenotype of an individual is derived from the hereditary material developing within a given environment. If environmental conditions are variable the outward manifestation of similar genetic factors may be different (the converse being equally true, but not so easily observed). The wide range of stature and weight measurements being influenced by such factors as nutrition and climate so that our phenotype patterns are extremely variable. Practically all the blood factors are known to be almost absolutely stable in the individual, except for rare changes in pathological conditions.

Red Cell Antigens

Since Landsteiner's work on the ABO groups, other separate blood group systems have been discovered in all of which inheritance has been shown to conform to Mendelian principles.

The ABO groups of man have been intensively studied and the distributions well-mapped because of the dramatic ill-effects arising from incompatible transfusion. Remarkably, the incidence of haemolytic disease of the new born arising from ABO incompatibility is low, but some specialists are doubtful of the sensitivity of the standard techniques

used for its detection. The Rhesus group in all its complexity has received much attention in connection with haemolytic disease of the newborn, whilst other systems such as Duffy, Kell and Kidd are known to incite haemolytic antibody formations but the specific conditions for this to occur are unknown.

All these serological systems and others besides, are variable in human populations. They will, in this thesis, be described among the Czechoslovakian Gipsies and the results compared with Gipsy and non-Gipsy groups in Europe and Northern India.

iv) PREVIOUS STUDIES OF THE SEROLOGICAL ANTHROPOLOGY OF GIPSY GROUPS

The application of blood grouping in anthropology is based upon the hereditary nature of the blood group, and the fact that there can be no conscious selection of mates dependent upon the blood groups. After the population has reached equilibrium, therefore, the proportions of the blood groups remain constant from generation to generation, provided there are no matings with other populations. As an illustration of this principle may be cited the observations of Verzar and Weszeczky, 1921 on the distribution of the blood groups in Gipsies. The Gipsies, scattered through Europe, have been studied serologically chiefly in Hungary, Yugoslavia and Romania.

In 1921 Verzar and Weszeczky determined the blood groups of some Hungarian Gipsies. Their results showed that the blood groups of the Gipsies still agreed quite well with those of Indian soldiers tested by the Hirszfelds at Salonika during World War I, and differed significantly from those of the Hungarians among whom they lived. All observers agree that the Gipsies have about 20% of the A gene together with B frequencies well above European levels. The average B gene frequencies for the different countries are: Yugoslavia 21%, Hungary 25%, and France 31%.

The frequencies of Rhesus negative are 12.7% in Hungary and 14.1% in France. In the French study the M gene grequency reaches the rather high level of 59.3%.

From 1921 up to 1979 the blood group tests have been done by several workers.

TABLE A

Dates	Systems Studied and Number of Studies	
1921-1930	ABO (7) - other systems not studied	Verzar et al (1921), Hesch (1930), Schmidt (1930), Libman (1930).
1931-1950	ABO (5)	Cartner (1932), Backhausz (1950), Rammeantu (1942), Rammeantu (1935) and Rammeantu (1938).
	Rh (1)	Backhause (1950).
1951-1970	ABO (6)	Marij Avcin (1969), Cazal (1951), Ely (1961), Ely (1966), Nicoli et al (1965), and Beckman et al (1965).
	MN (3)	Marij Avcin (1969), Cazal (1951) and Beckman et al (1965).
	Rh (6)	Marij Avcin (1969), Beckman et al (1965), Nicoli et al (1965), Ely (1966), Ely (1961) and Cazal (1951).
	HP (3)	Calikova et al (1969), Fraser et al (1969) and Beckman et al (1965).
	Tf (1)	Beckman et al (1965).
1971-1979	ABO (6)	Bernasovsky et al (1976), Bernasovsky et al (1975), Rex-Kiss et al (1973), Crawford (1971), Clarke (1973) and Harper et al (1977).
	MN (5)	Rex-Kiss et al (1973), Bernasovsky et al (1976), Harper et al (1977), Clarke (1973) and Crawford (1971).
	Ss (2)	Harper et al (1977) and Clarke (1973).
	Duffy (3)	Harper et al (1977), Clarke (1973) and Crawford (1971).
	KP (1)	Harper et al (1977).
	Kell (3)	Harper et al (1977) and Clarke (1973) and Bernasovsky (1976).
	Rh (5)	Bernasovsky et al (1976), Bernasovsky et al (1975), Rex-Kiss et al (1973), Clarke (1973) and Harper et al (1977).

TABLE A - Continued

Dates	Systems Studied and Number of Studies	
1971-1979	HP (3)	Rex-Kiss et al (1973), Harper et al (1977) and Clarke (1973).
	Tf (2)	Harper et al (1977) and Clarke (1973).
	ESD (2)	Harper et al (1977) and Welch et al (1974).
	AP (1)	Harper et al (1977).
	AK (2)	Harper et al (1977) and Sivakova (?)
	PGM (2)	Harper et al (1977) and Sivakova (?)

v) MATERIALS AND METHODS

1. Materials

Blood samples for the present investigation were obtained from Czechoslovakia (Slovakia) in 1976. One hundred and nineteen samples were evaluated. The specimens were sent to Durham by Dr V Ferak and his colleagues at the Department of Anthropology in the University of Bratislava. To whom grateful thanks are expressed. Blood received in the laboratory was immediately centrifuged for 10 minutes at 1000 RPM. A saline suspension of red cells was prepared for blood grouping. The rest of the red cells were stored at - 20^{o} for preparing haemolysates. No information apart from the name and sex of the donors was obtained.

2. Methods

The one hundred and nineteen samples were blood typed on arrival in the department by Miss L Bailey, the Chief Technician. The following is a brief summary of the three methods employed.

A Tile Method

Serum employed - anti A, anti B and anti A + B

This test was carried out by adding a drop of blood cell suspension (in physiological saline) to a drop of antiserum. The red cells/serum mixture was left for a specific period at a certain temperature. The tile was then moved gently back and forth and inspected for agglutination.

B Tube Method

Serum employed - anti C, anti c, anti D, anti E, anti S and anti CW

The tube method was performed by adding one volume of 5% saline suspension to one volume of antiserum in a preciptin tube. The serum/cell mixture was incubated for specific times at a certain temperature. After incubation, bovine albumin was carefully run down the side of the tube to cover the red cells. The cells were reincubated for 30 minutes and the results were read microscopically.

C Indirect Coombs Method

The following antisera were used - anti Fya, anti Fyb, anti K, anti K^{p}a, anti s, and all required anti globuline treatment before use.

This method involved placing equal volumes of red cells with antiserum in a precipitin tube. The serum/cell mixture was incubated for specific times at specified temperatures. After incubation, the cells were washed four times with physiological saline. The red cells were shaken well at the end of each washing. A drop of shaken red cells was mixed well with a drop of anti-human globulin. The tile was then rocked gently for 5-10 minutes and agglutination was observed over a strong light.

All the controls were set up at the same time, under the same conditions and were read immediately before the tests.

Electrophoresis was carried out on the 119 samples to determine their Haptoglobin, acid phosphatase, phosphoglucomutase, Esterase D, Adenylate Kinase and transferrin type.

The methods used is that described in the Department handbook.

Sixty-four samples were sent to the N.B.T.S. at Southampton to determine their Gregory antigen type.

CHAPTER I

RESULTS

In this study the phenotype and gene frequencies for the thirteen systems ABO, MN, Ss, Duffy, KP, Kell, Rh, HP, Transferrin, ESD, AP, AK and PGM which were found in the blood samples of the 119 Slovakian Gipsies are given in Table 1.

In Tables 1.1 to 1.13 these frequencies are juxtaposed with those found by other investigators of Gipsies from 10 European countries including Czechoslovakia and chi-squared values are given for comparisons between the present phenotype distribution and those of all the other populations.

Recent work on Gipsies has been reported from Hungary (Rex-Kiss and Szabo 1973), Czechoslovakia (Bernasovsky 1976), England (Clarke 1973) and Wales (Harper, Sunderland, Williams 1977). Some blood and serum groups (ABO, MN, Rh and HP) from Swedish Gipsies were studied by Beckman et al (1965), who found that in the MN, Rhesus and Haptoglobin systems there were significant differences between the Swedish Gipsies, the indigenous Swedish and other groups of European Gipsy populations. They attributed such differences to genetic drift within a social isolate.

Rex-Kiss et al (1973) studied the Hungarian Gipsies and tested 507-600 persons for ABO, MN, Rh and Haptoglobin types. They compared their results with other European Gipsies and those of Northern Indian populations and came to the conclusion that there are similarities between Hungarian Gipsies and the North Indian population, and no

genetic drift was observed in contrast to the Gipsy populations in Sweden, France and Yugoslavia.

A comparative study by Harper, Sunderland and Williams (1977), 84 Welsh Gipsies with other European Gipsy populations, showed that genetic divergence may have occurred in European Gipsy populations, because of the dispersal, isolation and inbreeding which has taken place during the present century.

The study by Bernasovsky et al (1976) of 2935 Gipsies in East Slovakia for the ABO, MN and Rhesus systems compares with Slovak non-Gipsies and reveals that the increased frequencies of the genes B and D in Czechoslovakian Gipsies provides evidence for their Indian origin. Again the work of Galikova et al (1969) in 360 Gipsies in Western and Eastern Slovakia for Haptoglobin types supports the hypothesis of the Indian origin of the Gipsies.

The 350 Gipsies from Slovenia (Yugoslavia) who were examined by Avcin (1961) for the ABO, MN and Rhesus systems showed a very low B gene frequency and a very low M gene frequency. He reported that the Gipsy settlements in Slovenia are isolates in the population genetic sense.

The ABO frequencies evinced by the majority of studies strongly support the theory of the Gipsies North Indian origin which is further suggested by the linguistic evidence. The MN and Rh frequencies do not differ significantly from those of European non-Gipsies. The French Gipsies, studied by Ely (1961, 1966) in Paris and Avignon, were also shown to be members of small isolates. In 1965 Beckman et al carried out research on 115 Swedish Gipsies from a total population of under 900. They showed that in Rhesus, MN and

Haptoglobin groups, there are significant differences between the Swedish Gipsies and other groups of European Gipsies. In the MN system the M gene frequency at 48% was lower than in French Gipsies as well as in the local Swedish population. There was a low B gene frequency of 6% and a high A gene frequency of 59%.

Other recent works on Gipsies have been reported from Hungary (Rex-Kiss and Szabo 1973), Czechoslovakia (Bernasovsky 1976), England (Clarke 1973) and Wales (Harper, Sunderland and Williams 1977). The Welsh Gipsies show a low B gene frequency (7.5%) and an M gene frequency of 46.4%, while the English Gipsies have a B gene frequency of 6.6% and a high M gene frequency of 70.2%. In Czechoslovakia the B gene frequency was shown to be 19.3% and the M gene frequency was shown to be 53%. In Hungary the B gene frequency shows a high level of 21.5% and an M gene frequency of 56%.

The frequency of Rhesus negatives are 12.7% in Hungary and 14.1% in France (Table 1-7), the incidence of Rh negative in the present study is 7.56%. This value is much lower than the average for European non-Gipsy populations.

Haptoglobin distributions in Gipsy population were studied by Beckman (1965), Galikova (1969), Fraser (1969), Clarke (1973), Rex-Kiss (1973) and Harper, Sunderland (1977) for Sweden, Czechoslovakia, Yugoslavia, England, Hungary and Wales respectively. The absence of the HP_1 gene in Swedish Gipsies is remarkable. Most Indian populations have a HP_1 gene frequency of 10.25% in contrast with that of 30-40% seen over Europe. Of the six Gipsy populations studied 5 show HP_1 values of less than 25%. While that for England is 41.7%.

In a Swedish study (Beckman 1965) the frequency of the Tfc gene was shown to be 100%, the corresponding figures for Wales (Harper, Sunderland and Williams 1977) and for England (Clarke 1973) are 98.1% and 98.6% respectively.

With regard to the iso-enzymes, very little work has been done, indeed the only studies on these polymorphisms in Gipsies are those of Wales (Harper, Sunderland 1977) for Esterase D, Acid phosphatase, Adenylate Kinase and phosphoglucomutase. England (Welch and Lee 1974) for Esterase D.

The ED, gene frequency in Welsh Gipsies was shown to be 94.9% while in England it was 89.5%.

The Gregory System

The Gregory blood group was first described by Swanson et al (1967). Anti Gy^a was present in the serum of Mrs Gregory who was a member of a family of Czechoslovakian origin living in the USA. Some of the family members were Gy(a-), an exceedingly rare condition in randomly selected individuals in any populations. Four other families, with a total of eleven Gy(a-) individuals, have been reported. One of these families, of Czechoslovakian origin but living in the USA, is apparently unrelated to the Gregory family (Moulds et al, 1973), there are two probably related families in Newfoundland (Massaquoi et al, 1973) and also the large, possibly inbred family of Mrs. L. in England (Clark et al, 1975). There is tenuous evidence that all the reported cases on both sides of the Atlantic might in some way be related and that they might have a Bohemian, possibly Gipsy origin. Mrs. L's family claims that some of its forebears were of true Romany stock. The kindred travelled extensively in south-west England, particularly in Devon and Dorset, and one of the Newfoundland families is believed to have originated in this area. Again, since some surnames recur in the kindred it is possible that the Gy(a-) individuals

are the product of a consanguineous mating and are presumably homozygous for the rare Gy(a-) gene, inherited from a common ancester (Clark et al, 1975). It is certainly of great interest that all those individuals found to carry the rare Gregory blood group Gy(a-) have Czechoslovakian and possibly Gipsy origin (Clark et al, 1975; Harper, Sunderland and Williams, 1977) and it seemed very appropriate to examine the present series. Sixty four of the present samples were tested by Dr. R.M. Barnes of the Southampton N.B.T.S. and grateful thanks are expressed to him for doing so. All the specimens tested were found to be Gy(a+).

Discussion

Examinations of ABO blood groups - twenty four publications are found in the literature reporting results of ABO blood group examinations of Gipsies (Table 1.1). There are four each on Hungarian, Romanian and French Gipsies, five on Yugoslavian, one each on Swedish, English, Welsh Russian and Irish Gipsies and two on Czechoslovakian Gipsies. The examinations cover 8063 Gipsies in all. It is a rather small number relative to the total of one million European Gipsies. The number of individuals tested in the Gipsy populations is as follows:

Hungary 2149, Yugoslavia 879, Romania 737, France 293, Sweden 115, Czechoslovakia 3488, Soviet Union 104, England 109, Ireland 119 and Wales 70.

Verzar and Weszeczky (1921) were the first to establish that among Gipsies the A gene frequency is lower and the B gene frequency is much higher than in any European population and that these frequencies

corresponded to the values for soldiers of Indian origin as found by Hirschfeld (1919). Later examinations confirmed that the frequency of the group B, and of the B gene (q), which have ranges of 10-20% and 0.09 - 0.15 respectively in indigenous European populations, are much higher among the Gipsies, namely 26.1 - 39.4% and 0.1924 - 0.3023 respectively.

It can be seen from Table 1.1 that in the present study there are significant differences compared with some previous data in the frequency of the B group, the B phenotype frequency being 29.41% in the Gipsy population tested, whereas it has been found to be 10.28% in Slovenian Gipsies (Avcin 1961) $P<0.01$, 38.92 in Hungarian Gipsies (Verzar et al 1921), $P<0.01$, 40.54% in Yugoslavian Gipsies (Schmidt 1930) $P<0.05$ and surprisingly very low in Swedish Gipsies 6.1% (Beckman et al 1965) $P<0.01$ and 8.26% in England (Clarke 1973) $P<0.01$. For the B phenotype there are no significant differences between the present study and the Czechoslovakian study of Berna Sovsky et al (1975, $P>0.20$), the Hungarian study of Rex-Kiss (1973, $P>0.20$), the Romanian studies of Hesch (1930, $P>0.50$) and Rammeantu (1942, $P>0.70$, and 1938, $P>0.1$), Yugoslavian studies of Schmidt (1930, $P>0.80$ and $P>0.10$), French Studies of Cazal (1951, $P>0.70$) and Ely (1966, $P>0.30$).

The AB phenotype frequency in the present study is 15.97% and is the highest reported among European Gipsies (Table 1.1), with the exception of the Gipsies from Transylvania where the frequency is 17.30% (Rammeantu 1935).

The Swedish, Welsh, Yugoslavian and French Gipsy populations studied by Beckman, Tackman and Arfors 1965, Harper, Sunderland and Williams 1977, Marij Avcin 1969 and Ely 1961 and 1966 are all to varying extents isolated populations. As such all these populations

are likely to have been subject to random influences such as genetic drift and the founder effect which may have produced wide genotypic deviations from the ambient populations (Avcin 1969, Harper, Sunderland and Williams 1977, Beckman et al 1965). A comparison of the present population (1) with the earlier Czechoslovakian Gipsy studies leads to interesting observations. The results of Bernasovsky et al 1976 in East Slovakia (2) show a B gene frequency of 0.193 whereas in a second series Bernasovsky et al 1975 in Rozanova (3) (South East Slovakia) the B gene frequency is 0.2085. The chi-squared test shows a significant difference between the present results and the first series from Slovakia ($P<0.05$) but no difference from the second series ($P>0.20$).

There is, in turn, no significant difference between the ABO distributions of the two previous Slovakian studies. This may be because, although the differences between populations 1 and 3 and between populations 2 and 3 are not significant, they do exist and population 2 is farther removed from population 1 than population 3.

Since Czechoslovakian Gipsies live in social groups which have varying degrees of assimilation with the indigenous populations ('assimilated', 'semiassimilated' and 'non-assimilated') - and there is no ethnographic evidence of their degrees of admixture, these disparities need hardly surprise us.

Regarding the relation of the frequencies of genes A and B in the majority of studies on European Gipsies, the ratio of the frequencies of genes A and B (ie $^{A}/_{B}$) has been found to exceed unity with some populations achieving very high values (e.g. the Southern French series of Nicoli and Sermet has an $^{A}/_{B}$ ratio of 3.02 and the Swedish series of Beckman et al shows a ratio of 7.93). $^{A}/_{B}$ ratios smaller than unity occur in Hungarian, Romanian, Yugoslavian and the present study, and in

this respect at least these Eastern European Gipsy populations conform more closely to the ancestral Indian values (the Indian $^{A}/_{B}$ ratio is 0.60).

Examinations of M-N Groups

Data on MN examinations in Gipsies can be found only in eight publications. Significant differences can be observed in the frequency of all three phenotypes and the calculated m gene frequencies (Table 1.2) compared with each other and with those of European populations (Table 1.A) (the values of the m gene frequencies for European populations lie between 0.40 - 0.50, Mourant 1970, Boyd 1953). The chi-squared test shows a significant difference between the present population and each of the other seven series, the only exception being the French Gipsies (Cazal et al 1951) $P>0.10$. This is not surprising if one considers that isolates and endogamous populations are in question (Rex-Kiss et al 1973, M Avcin 1968).

Ss System

Data for comparison with other European Gipsy populations are not as easily available in the Ss system as in the ABO and MN systems. Ss blood groups were determined on the small number of Welsh Gipsies (Harper, Sunderland, Williams 1977) and English Gipsies (Clarke 1973). The S gene frequency is 0.2350 in the English series whereas in Welsh Gipsies it is higher than in the present study (Table 1.3). The chi-squared test shows a significant difference between the present population and the Welsh Gipsies ($P<0.02$).

The Duffy System

Duffy examinations on the Gipsies were made hitherto by Crawford

(1971) on Irish Tinkers, Clarke (1973) and Harper, Sunderland and Williams (1977) on English and Welsh Gipsies respectively (Table 1.4). The chi-squared test shows no significant difference between these Gipsy populations and the surrounding populations.

KP Blood Group Examinations

A study of the KP system in the Gipsies was made by Harper, Sunderland, Williams (1977) on Welsh Gipsies (Table 1.5) - no other study has been located. The very small Gipsy group (n=59) here tested exhibits a high gene frequency of KPb = 100. There appears to be no difference between the two series.

Kell Blood Group System

Table 1.6 shows the distribution of the Kell blood group system in four Gipsy populations: from Wales - Harper, Sunderland, Williams (1977), Czechoslovakia - Bernasovsky et al (1976), England - Clarke (1973) and the present study. The frequency of the gene K is lower in the present study (0.0168), the Welsh Gipsies (0.00) and the English series (0.034) than in the Czechoslovakian series of Bernasovsky et al (0.0498). Though not many data are available for comparison it is clear from what is available that the Kell positive gene frequency of 0.0168 in the present study and of 0.034 in the English Gipsy populations are lower than the European levels, whereas Czechoslovakian Gipsies with 0.0498 is similar to Czechoslovakian non-Gipsies.

Examinations of Rh Types

Table 1.7 presents the results for 13 Gipsy populations. As regards the frequency of the gene d it is found that most of the Gipsy results lie within the European range of 30-45% and differ considerably from the

frequencies in the Indian subcontinent which range from 10-30%. Only the present population (27.5), the Czechoslovakian population of Bernasovsky 1975 (28.84), the Swedish series of Beckman et al 1965 (20.9) the French Gipsies of Ely 1961 (15.4) and the Welsh series of Harper Sunderland and Williams 1977 (20.7) are similar to those found in Indian populations.

The chi-squared test shows no significant difference between these Gipsy populations and the present Slovakian series. The only exception being the Yugoslavian series of Hocevar 1969 ($P<0.01$).

In the present study the characteristic of the phenotype frequencies is the low incidence of phenotype CcDEe (R1R2), absence of phenotypes R2r (ccDEe), R2R2 (ccDEE) and the high one of R1r (CcDee) and R1R1 (CCDee).

The first Rh tests on 107 French Gipsy population were reported by Cazal et al (1951) and were determined by the use of Anti C, D, E and c-sera. The chromosome frequencies in European Gipsy populations (Table 1.7) are in agreement though relatively small numbers of subjects were studied. The major disagreement appears to be the absence of the complex Ry in the populations studied, the only exception being the English series (Clarke 1973).

The Hungarian Gipsy population (Rex-Kiss 1973) show the presence of phenotypes rr′ and Ror, French and Slovenian Gipsy populations (Cazal 1951, Hocevar 1965 respectively) show the presence of phenotype rr′. The present study, Hungarian Gipsies (Rex-Kiss et al 1973), Swedish Gipsies (Beckman et al 1965) and French Gipsy populations (Cazal 1951) show low frequencies of cDE (R2) and high CDe(R1) tending towards Indian values, but those of Yugoslavia (Hocevar 1965), England (Clarke 1973) and

and Wales (Harper, Sunderland and Williams 1977) differ in the frequencies of the Rh gene complex.

The Yugoslavian Gipsies (Hocevar 1965) differed considerably from those of Southern France, studied by Cazal (1951) who had 18% more of the CDe chromosome (R1), 10% less of the cDE (R2) and 9% more of the cde(r) chromosome.

Serum Proteins

The results for two serum protein systems are as follows:

i Table 1.8 shows the distribution of Haptoglobin groups and gene frequencies in the present Gipsy population. HP type examinations on Gipsies have hitherto been carried out in Czechoslovakia (Galikova 1969), Yugoslavia (Fraser 1969), Hungary (Rex-Kiss 1973), Wales (Harper, Sunderland, and Williams 1977), England (Clarke 1973) and Sweden (Beckman 1965). The striking peculiarity in most publications is the low frequency of the phenotype HP1-1 and correspondingly, of the gene HP1 the only exception being the English series of Clarke (1973) with HP1 = 0.417. The survey by Galikova et al in Slovakia, revealed an interesting difference in the distribution of HP types between Gipsies living in West compared with East Slovakia, the occurrence of the HP1 gene was found to be significantly higher in west Slovakia. The HP1 gene frequency of Swedish Gipsies (11.7%) is exceptionally low in comparison with the corresponding frequencies in the series from Slovakia (15.0%) the present study (17.27%), Yugoslavia (17.1%), Hungary (20.4%) and Wales (23.7%. The English Gipsies' HP1 frequency (41.7%) is unusually high.

ii Transferrin: Table 1.9 shows the distribution of Transferrin groups and gene frequencies in the present Gipsy population.

To the Author's knowledge Transferrin type examinations of Gipsies were hitherto carried out only in Sweden (Beckman et al 1965), Wales (Harper, Sunderland and Williams 1977) and England (Clarke 1973). In the first two series present Slovakian and Sweden only Transferrin C(Tfc) was found, and in the second two series in Wales and England, phenotypes (C) and (Bc) were detected.

Red Cell Isoenzymes

The results of various enzyme systems are given below:

i Table 1.10 reveals the distribution of Esterase D phenotype and gene frequencies among Gipsy populations. Only two sets of published date are available for this system, those from Wales (Harper, Sunderland, and Williams 1977) and England (Welch and Lee 1974). Chi-squared tests show significant differences between the present study and the Welsh Gipsies ($P<0.01$) and also between the present study and the English Gipsies ($P<0.05$).

ii Acid Phosphatase: The results for the AP system are set out in Table 1.11. Comparing the results of AP examinations with those made on Gipsies in Wales (Harper, Sunderland and Williams 1977), high Pc gene frequencies were found in the both series.

iii Adenylate Kinase: Table 1.12 shows the distribution of AK groups and their respective gene frequencies. The

only other study on this Polymorphism in Gipsies is in Wales (Harper, Sunderland, and Williams 1977). Only AK1-1 was found in Welsh Gipsies, and there is no significant difference between the two series.

iv Phosphoglocomutase: The results of the PGM system are given in Table 1.13. Only one other set of data is available in the PGM system. The phosphoglocomutase type were determined on the small number of Welsh Gipsies (Harper, Sunderland and Williams 1977). The PGM2 gene frequency is 0.196 in the Welsh series whereas in the present study it is much higher at 0.308. However the chi-squared test shows no significant difference between the two series ($P>0.10$).

TABLE 1 - A Czechoslovakian (Slovak) Gipsies Phenotypes and Gene Frequencies

Blood Group Systems	Phenotypes	n	%	Gene Frequencies
ABO	0	34	28.57	r = 0.5089
	A	31	26.05	p = 0.2345
	B	35	29.41	q = 0.2565
	AB	19	15.97	
	Total	119		
MN	MM	37	31.1	m = 0.6135
	NN	10	8.4	n = 0.3865
	MN	72	60.5	
	Total	119		
Ss	SS	8	6.8	S = 0.261
	ss	65	54.6	s = 0.739
	Ss	46	38.6	
	Total	119		
Fy	Fya	46	38.66	Fya = 0.5336
	Fyb	38	31.93	Fyb = 0.4664
	Fya,b	35	29.41	
	Total	119		
Kp	Kpa	0	0	KPa = 0.0047
	Kpb	106	99.07	KPb = 0.9953
	Kpa,b	1	0.93	
	Total	107		
Kell	KK	0	0	K = 0.0168
	kk	115	96.64	k = 0.9832
	Kk	4	3.36	
	Total	119		

TABLE 1 - Continued - A Czechoslovakian (Slovak) Gipsies Phenotypes and Gene Frequencies

Blood Group Systems	Phenotypes	n	%	Gene Frequencies
Rh	D+	110	92.44	D = 0.725
	D-	9	7.56	d = 0.275
	Total	119		
HP	HP1-1	4	3.63	HP1 = 0.1727
	HP2-2	76	69.09	HP2 = 0.8273
	HP2-1	30	27.28	
	Total	110		
Tf	TfC	59	100.0	Tfc = 1
	TfBC	0	0	TfB = 0.00
	Total	59		
ESD	1-1	80	67.23	ED1 = 0.8235
	2-2	3	2.52	ED2 = 0.1765
	2-1	36	30.25	
	Total	119		
AP	A	9	9.89	PA = 0.3077
	AB	35	38.46	PB = 0.6484
	B	40	43.96	Pc = 0.0439
	BC	3	3.30	
	CA	3	3.30	
	C	1	1.09	
	Total	91		
AK	1-1	113	94.96	AK1 = 0.9748
	2-2	0	0	AK2 = 0.0252
	2-1	6	5.04	
	Total	119		
PGM	1-1	58	51.79	PGM1 = 0.692
	2-2	15	13.39	PGM2 = 0.308
	2-1	39	34.82	
	Total	112		

TABLE 1.1 - ABO Blood Group Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes				Gene Frequencies			Chi-squared value for comparison with present study
			O	A	B	AB	P	q	r	
Swedes	Beckman, Tackman and Arfors 1965	115	36 31.30	68 59.14	7 6.09	4 3.47	0.389	0.049	0.562	P<0.01
England	Clarke 1973	109	43 39.45	52 47.71	9 8.26	5 4.58	0.3087	0.0663	0.6250	P<0.01
Wales	Harper, Sunderland and Williams 1977	70	30 42.86	30 42.86	10 14.28	0	0.248	0.075	0.676	P<0.01
Yugoslavia (Slavonic)	Marij Avcin 1969 Hocvar 1965	350	120 34.29	173 49.43	36 10.28	21 6.0	0.33	0.0878	0.5822	P<0.01
France (South)	Nicoli and Sermet 1965	92	39 42.40	37 40.21	9 9.79	7 7.6	0.2750	0.0902	0.6348	P<0.01
Ireland	Crawford 1971	119	-	-	-	-	0.2010	0.1208	0.6859	
France (North)	Ely 1961	47	25 53.2	10 21.3	9 19.1	3 6.4	0.148	0.136	0.716	P<0.05
Yugoslavia (Backa, Monostor)	Schmidt 1930	126	42 33.33	50 39.68	25 19.84	9 7.14	0.2717	0.1460	0.5823	P<0.02

TABLE 1.1 - Continued - ABO Blood Group Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes				Gene Frequencies			Chi-squared value for comparison with present study
			o	A	B	AB	P	q	r	
Romania (Transylvania)	Rammeantu 1938	98	38 38.78	33 33.67	18 18.37	9 9.18	0.2422	0.1477	0.6101	P>0.10
Yugoslavia (Aptain, Backa)	Schmidt 1930	299	134 44.82	69 23.08	73 24.41	23 7.69	0.1669	0.1748	0.6583	P<0.01
Czechoslovakia (East-Slovak)	Bernasovsky et al 1976	2935	885 31.01	1037 35.33	740 25.21	273 8.45	0.258	0.193	0.549	P<0.05
Czechoslovakia (Roznava)	Bernasovsky et al 1975	553	165 29.84	186 33.64	151 27.31	51 9.22	0.2448	0.2039	0.5512	P>0.20
France (South)	Ely 1966	41	9 21.9	17 41.4	11 26.8	4 9.7	0.306	0.206	0.488	P>0.30
Hungary (settled Gipsies)	Rex-Kiss et al 1973	600	162 27.0	206 34.3	168 28.0	64 10.7	0.2635	0.2169	0.5196	P>0.20
USSR (Uzbekistan)	Libman(1) 1930	104	20 19.23	44 42.31	30 28.85	10 9.61	0.3126	0.2197	0.4677	P<0.02
Romania (Soldiers)	Rammeantu, Lustrea 1942	94	28 29.79	29 30.85	28 29.79	9 9.57	0.2287	0.2218	0.5495	P>0.70
Czechoslovakia (Slovakia) (1) Quoted by Hocever 1965	Present Study	119	34 28.57	31 26.05	35 29.41	19 15.97	0.2345	0.2565	0.5089	

TABLE 1.1 - Continued - ABO Blood Group Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes				Gene Frequencies			Chi-squared value for comparison with present study
			O	A	B	AB	P	q	r	
Hungary (Haydu) North Hungary	Verzar and Weszeczky 1921	385	132 34.29	81 21.04	150 38.96	22 5.71	0.1450	0.2580	0.5970	P<0.01
Hungary (Bihar) Wandering Gipsies	Cartner 1932	975	278 28.51	259 26.56	344 35.28	99 10.15	0.2025	0.2586	0.5388	P<0.02
Romania (N. Transylvania)	Hesch 1930	102	27 26.47	28 27.45	38 37.26	9 8.82	0.2036	0.2681	0.5283	P>0.50
Nomedic (Yugoslavia)	Schmidt 1930	30	6 20.0	10 33.33	10 33.33	4 13.33	0.2715	0.2715	0.4570	P>0.80
Romania (S.E. Transylvania)	Rammeantu 1935	443	75 16.93	141 31.75	151 34.01	76 17.30	0.2859	0.3019	0.4122	P<0.05
France (South)	Cazal et al 1951	113	25 22.1	29 25.7	43 38.1	16 14.1	0.2239	0.3082	0.4679	P>0.70
Yugoslavia (Bogojevo, Backa)	Schmidt 1930	74	8 10.81	26 35.14	30 40.54	10 13.51	0.25	0.388	0.329	P<0.05

TABLE 1.2 - MN Blood Group Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			MM	MN	NN	M	N
Slovenia (Prekmurje)	Hocvar Avcin 1969	350	67 19.14	164 46.86	119 34.0	0.4257	0.5743
Wales	Harper, Sunderland and Williams 1977	70	16 22.85	33 47.15	21 30.0	0.464	0.536
Swedes	Beckman et al 1965	115	23 20.0	64 55.7	28 24.3	0.478	0.522
Czechoslovakia	Bernasovsky et al 1976	405	110 27.16	209 51.60	86 21.23	0.5297	0.4703
Ireland	Crawford 1971	119	-	-	-	0.5466	0.4533
Hungary	Rex-Kiss et al 1973	536	166 31.0	267 49.8	103 19.2	0.5588	0.4412
France	Cazal et al 1951	86	31 36.05	40 46.51	15 17.44	0.593	0.407
Czechoslovakia	Present Study	119	37 31.092	72 60.504	10 8.403	0.6135	0.3865
England	Clarke 1973	109	54 49.54	45 41.29	10 9.17	0.702	0.298

TABLE 1.3 - Ss Blood Group Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			SS	ss	Ss	S	s
Czechoslovakia (Slovakia)	Present Study	119	8 6.8	65 54.6	46 38.6	0.261	0.739
Wales	Harper, Sunderland and Williams 1977	70	45 64.29	25 35.71	-	0.402	0.598
England	Clarke 1973	109	45 41.29	64 58.71	-	0.235	0.765

TABLE 1.4 - Duffy Blood Group Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			Fya	Fyb	Fya Fyb	Fya	Fyb
Czechoslovakia (Slovakia)	Present Study	119	46 38.66	38 31.93	35 29.41	0.534	0.466
Wales	Harper, Sunderland and Williams 1977	69	44 63.77	25 36.23	-	0.398	0.602
England	Clarke 1973	106	63 59.43	43 40.57	-	0.362	0.638
Ireland	Crawford 1971	119	-	-	-	0.3519	0.6481

TABLE 1.5 - KP Blood Group Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			KPa	KPb	KPa KPb	KPa	KPb
Czechoslovakia (Slovakia)	Present Study	107	0 0	106 99.07	1 0.93	0.0047	0.9953
Wales	Harper, Sunderland and Williams 1977	59	0 0	59 100.0	-	0.00	1

TABLE 1.6 - Kell Blood Group Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			K+k+	k-k-	K+k-	K	k
Czechoslovakia (Slovakia)	Present Study	119	0 0.0	115 96.64	4 3.36	0.0168	0.9832
Wales	Harper, Sunderland and Williams 1977	70	0 0.0	70 100.0	-	0.00	1
England	Clarke 1973	108	5 4.63	103 95.37	-	0.034	0.976
Czechoslovakia	Bernasovsky et al 1976	559				0.0498	0.9502

TABLE 1.7 - Rh Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes		Gene Frequencies	
			D+	D-	D	d
France (North)	Ely 1961	42	41 97.62	1 2.38	0.846	0.154
Wales	Harper, Sunderland and Williams 1977	70	67 95.71	3 4.29	0.793	0.207
Sweden	Beckman et al 1965	115	110 95.65	5 4.35	0.791	0.209
Czechoslovakia (Slovakia)	Present Study	119	110 92.44	9 7.56	0.725	0.275
Czechoslovakia	Bernasovsky et al 1975	553	507 91.7	46 8.3	0.7116	0.2884
Hungary	Rex-Kiss et al 1973	507	455 89.74	52 10.26	0.68	0.32
Czechoslovakia	Bernasovsky 1976	2935	2628 89.54	307 10.46	0.676	0.323
France (South)	Ely 1966	41	36 87.8	5 12.2	0.651	0.349

TABLE 1.7 - Continued - Rh Phenotypes and Gene Frequencies in some European Gipsies

Population	Author	Number	Phenotypes		Gene Frequencies	
			D+	D-	D	d
France (South)	Nicoli et al 1965	81	71 87.65	10 12.35	0.649	0.351
Hungary	Backhausz et al 1950	189	165 87.3	24 12.7	0.644	0.356
England	Clarke 1973	109	93 85.32	16 14.68	0.617	0.383
France (South)	Cazal et al 1951	107	91 85.05	16 14.95	0.613	0.387
Yugoslavia (Slovenia)	Hocvar 1965 Avcin 1969	350	284 81.14	66 18.86	0.566	0.434

TABLE 1.7 - Continued - Rh Phenotypes in some European Gipsies

Populations	rr	R1r	R1R1	Ror	R2r	R2R2	r′r′	rr′	R2R1	r″r′	RzR1	Total
Present Study	9 7.56	37 31.09	64 53.79	-	-	-	-	-	9 7.56	-	-	119
Wales Harper et al 1977	2 2.86	17 24.28	23 32.86	-	9 12.86	6 8.57	-	-	12 17.14	1 1.43	-	70
Hungary Rex-Kiss 1973	49 9.7	190 37.5	202 39.9	2 0.4	18 3.5	-	-	3 0.6	43 8.5	-	-	507
Slovenia Hocevar 1965	50 14.28	130 37.13	85 24.38	-	20 5.71	6 1.70	2 0.57	14 4.0	42 12.0	-	1 0.28	350
Sweden Beckman et al 1965	4 3.48	-	88 76.52	-	-	7 6.09	1 0.87	-	-	-	15 13.04	115
France Cazal 1951	14 13.08	30 28.04	52 48.6	4 3.74	-	1 0.93	-	2 1.87	4 3.74	-	-	107
England Clarke 1973	14 12.84	34 31.2	28 25.7	-	-	11 10.1	-	1 0.91	9 17.43	-	-	109 (1)

(1) r″r 1 0.91 RzRz 1 0.91

TABLE 1.7 - Continued - Chromosome Frequencies in Some European Gipsies

Populations	r cde	r′ Cde	r″ cdE	Ry CdE	Ro cDe	R1 CDe	R2 cDe	Rz CDE
Present Study	0.2311	0.00	0.00	0.00	0.00	0.7311	0.0378	0.00
Wales Harper et al 1977	0.2214	0.00	0.0308	0.00	0.00	0.5357	0.2121	0.00
Hungary Rex-Kiss 1973	0.3108	0.0095	0.00	0.00	0.0063	0.6039	0.052	0.0022
Slovenia Hocevar 1965	0.3768	0.0564	0.00	0.00	0.00	0.4431	0.1209	0.0028
Sweden Beckman et al 1965	0.1997	0.0205	0.00	0.00	0.00	0.6779	0.1019	0.00
France Cazal 1951	0.2841	0.0329	0.00	0.00	0.0380	0.6213	0.0236	0.00
England Clarke 1973	0.2936	0.0128	0.0211	0.0046	0.00	0.4918	0.1761	0.00

TABLE 1.8 - Haptoglobin Types in Some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			1-1	2-1	2-2	HP1	HP2
Sweden	Beckman et al 1965	115	0 0.0	27 23.5	88 76.5	0.117	0.883
Czechoslovakia	C A Likova et al 1969	360	6 1.66	96 26.67	258 71.67	0.15	0.85
Yugoslavia Skopje (South East)	Fraser et al 1969	38	2 5.26	9 23.69	27 71.05	0.171	0.829
Czechoslovakia (Slovakia)	Present Study	110	4 3.63	30 27.28	76 69.09	0.1727	0.8273
Hungary	Rex-Kiss et al 1973	520	30 5.8	152 29.2	336 69.6	0.204	0.796
Wales	Harper Sunderland and Williams 1977	76	3 3.95	30 39.47	43 56.58	0.237	0.763
England	Clarke 1973	103	16 15.53	54 52.43	33 32.04	0.417	0.583

HP 0-0
2
0.4

TABLE 1.9 - Transferrin Types in Some European Gipsies

Population	Author	Number	Phenotypes		Gene Frequencies	
			C	Bc	C	B
Czechoslovakia (Slovakia)	Present Study	59	59 100.0	0 0.0	1	0.00
Sweden	Beckman et al 1965	115	115 100.0	0 0.0	1	0.00
Wales	Harper Sunderland and Williams 1977	77	74 96.1	3 3.9	0.981	0.019
England	Clarke 1973	103	100 97.09	3 2.91	0.986	0.014

TABLE 1.10 - Esterase D Phenotypes and Gene Frequencies in Some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			1-1	2-1	2-2	ED1	ED2
Czechoslovakia (Slovakia)	Present Study	119	80 67.23	36 30.25	3 2.52	0.8235	0.1765
Wales	Harper Sunderland and Williams 1977	68	61 89.7	7 10.3	0 0.0	0.949	0.051
England	Welch, Lee 1974	153	122 79.74	30 19.61	1 0.65	0.895	0.105

TABLE 1.11 - Acid Phosphatase Phenotypes and Gene Frequencies in Some European Gipsies

Population	Author	Number	Phenotypes						Gene Frequencies		
			A	AB	B	BC	CA	C	PA	PB	PC
Czechoslovakia (Slovakia)	Present Study	91	9 9.89	35 38.46	40 43.96	3 3.30	3 3.30	1 1.09	0.3077	0.6484	0.0439
Wales	Harper, Sunderland and Williams 1977	64	12 18.75	19 29.69	28 43.75	5 7.81	-	-	0.336	0.625	0.039

TABLE 1.12 - Adenylate Kinase Phenotypes and Gene Frequencies in Some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			1-1	2-1	2-2	AK1	AK2
Czechoslovakia	Present Study	119	113 94.96	6 5.04	0 0.0	0.9748	0.0252
Wales	Harper Sunderland and Williams 1977	71	71 100.00	0 0.0	0 0.0	1	0
Czechoslovakia	D. Siva Kova	158				0.9841	0.0159

TABLE 1.13 - Phosphoglocomutase Phenotypes and Gene Frequencies in Some European Gipsies

Population	Author	Number	Phenotypes			Gene Frequencies	
			1-1	2-1	2-2	PGM1	PGM2
Czechoslovakia (Slovakia)	Present Study	112	58 51.79	39 34.82	15 13.39	0.692	0.308
Wales	Harper Sunderland and Williams 1977	69	45 65.22	21 30.43	3 4.35	0.805	0.196
Czechoslovakia	D. Siva Kova	231				0.6558	0.3442

CHAPTER II

COMPARATIVE STUDIES

A comparison of the blood groups of the European Gipsies and those of indigenous Europeans indicates a great disparity and clearly splits the data into two separate groups, Gipsies on the one hand and indigenous people on the other.

A comparison of the blood groups of the European Gipsies with those of Northern India populations leaves no doubt that the Gipsies who have been living outside India for many centuries are all of the same Indo Aryan racial stock. Investigations concerning the morphological measurements of the people of India were begun during the latter half of the last century. Comprehensive studies on the subject were undertaken by Risley (1915) and Guha (1931), both of whom studied a large number of individuals comprising several different groups. However, investigations concerning genetical traits have been few in India as compared with some other countries of the World.

Preliminary studies carried out on Indians of their genetic Polymorphic systems started in the early decades of the century with the ABO blood groups (Hirszfeld 1919). At present most of the data on the blood groups are restricted to the ABO, Rhesus and MN systems. Knowledge about the other systems like Duffy, Kell, etc is still deficient.

Later researches carried out by Sanghvi reported striking genetical differences among the endogamous groups and suggested that it may be of great interest to examine other such isolated groups who could contribute to the better understanding of polymorphism in the Indian

sub-contient.

In recent years information regarding the other systems such as haemoglobin types and isoenzyme systems has been published for different populations in India (Das 1970), Blake et al (1970, 1971), Das (1978). However, the studies conducted on the various Indian populations, including some in Northern India, the probable place of origin of the European Gipsies, are limited and information about the frequency distribution of various genetic parameters is scanty, not only among the tribal populations, but also within the urban communities.

This section presents a comparative study of the gene and phenotype frequencies of different serological systems examined in this survey.

Blood Group Systems

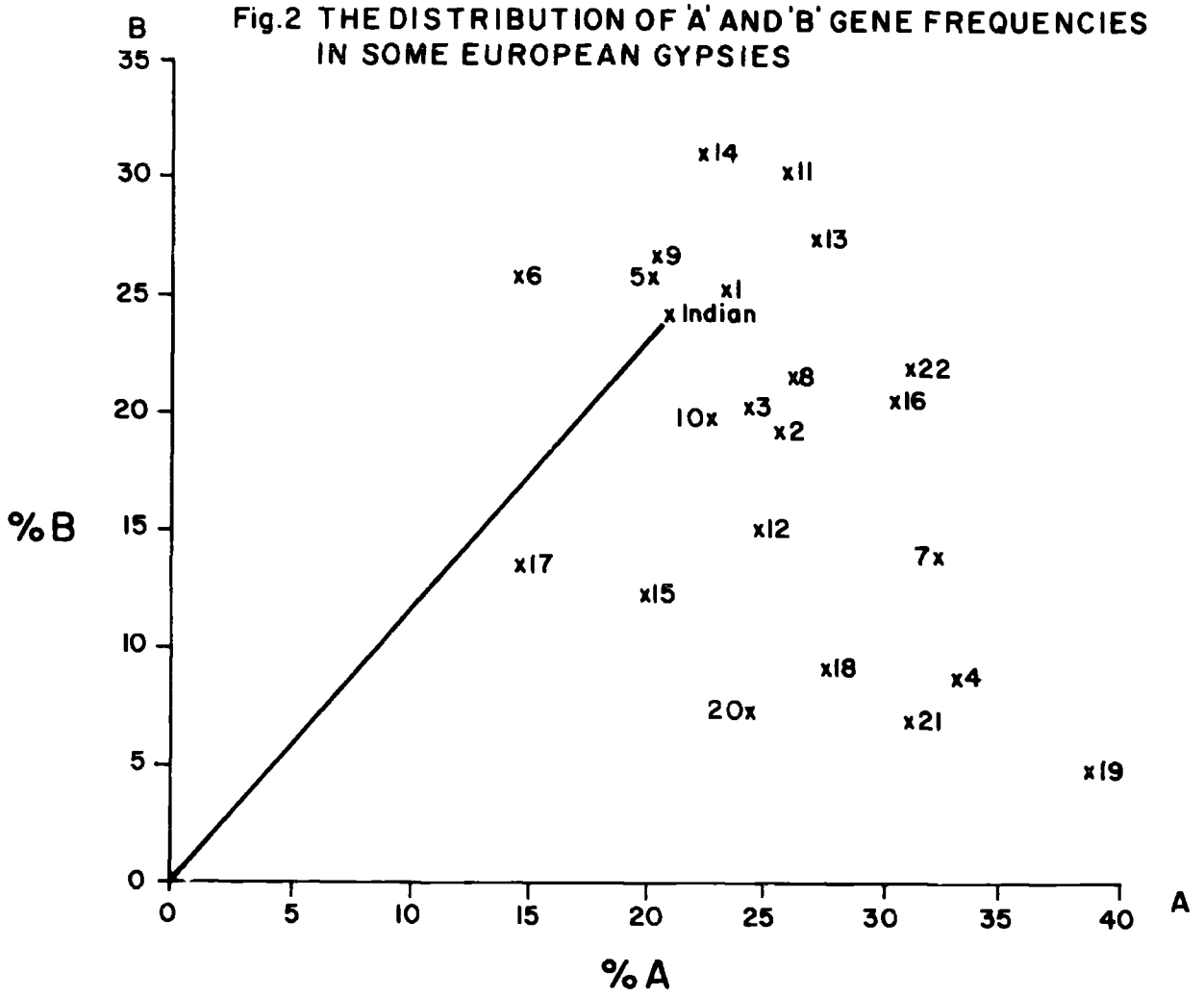
The results for different blood group systems (phenotypes and gene frequencies) of the European Gipsy, and non-Gipsy populations are compared with those of Northern India are given in Tables 2-2I.

Discussion

ABO Blood Groups: The gene frequency distribution in Northern Indian populations reveals a preponderance of gene r with a frequency of 40-60%. The frequency of q varies generally between 20-30% and that of p between 15 and 20 per cent. The frequencies exhibited by the present study of Czechoslovakian (Slovak) Gipsies fit into this range.

Tables 2-2I present the distribution of the ABO blood groups in Northern Indian population, comparing this with the distributions found in the larger studies of European Gipsy populations. The frequency value of gene B (q) and the quotient P/q is seen to be close to the

Fig.2 THE DISTRIBUTION OF 'A' AND 'B' GENE FREQUENCIES IN SOME EUROPEAN GYPSIES



THE KEY

1	Present Study	12	Romania (Rammeantu 1938)
2	Czechoslovakia (1976)	13	Yugoslavia (Schmidt 1930)
3	Czechoslovakia (1975)	14	France (Cazal 1951)
4	Yugoslavia (Avcin 1969)	15	Ireland (Crawford 1971)
5	Hungary (Cartner 1932)	16	France (Ely 1966)
6	Hungary (Verzar 1921)	17	France (Ely 1961)
7	Hungary (Backousz 1950)	18	France (Nicoli 1965)
8	Hungary (Rex-Kiss 1973)	19	Sweden (Beckman 1965)
9	Romania (Hesch 1930)	20	Wales (Harper 1977)
10	Romania (Rammeantu 1942)	21	England (Clarke 1973)
11	Romania (Rammeantu 1935)	22	USSR (Libman 1930)

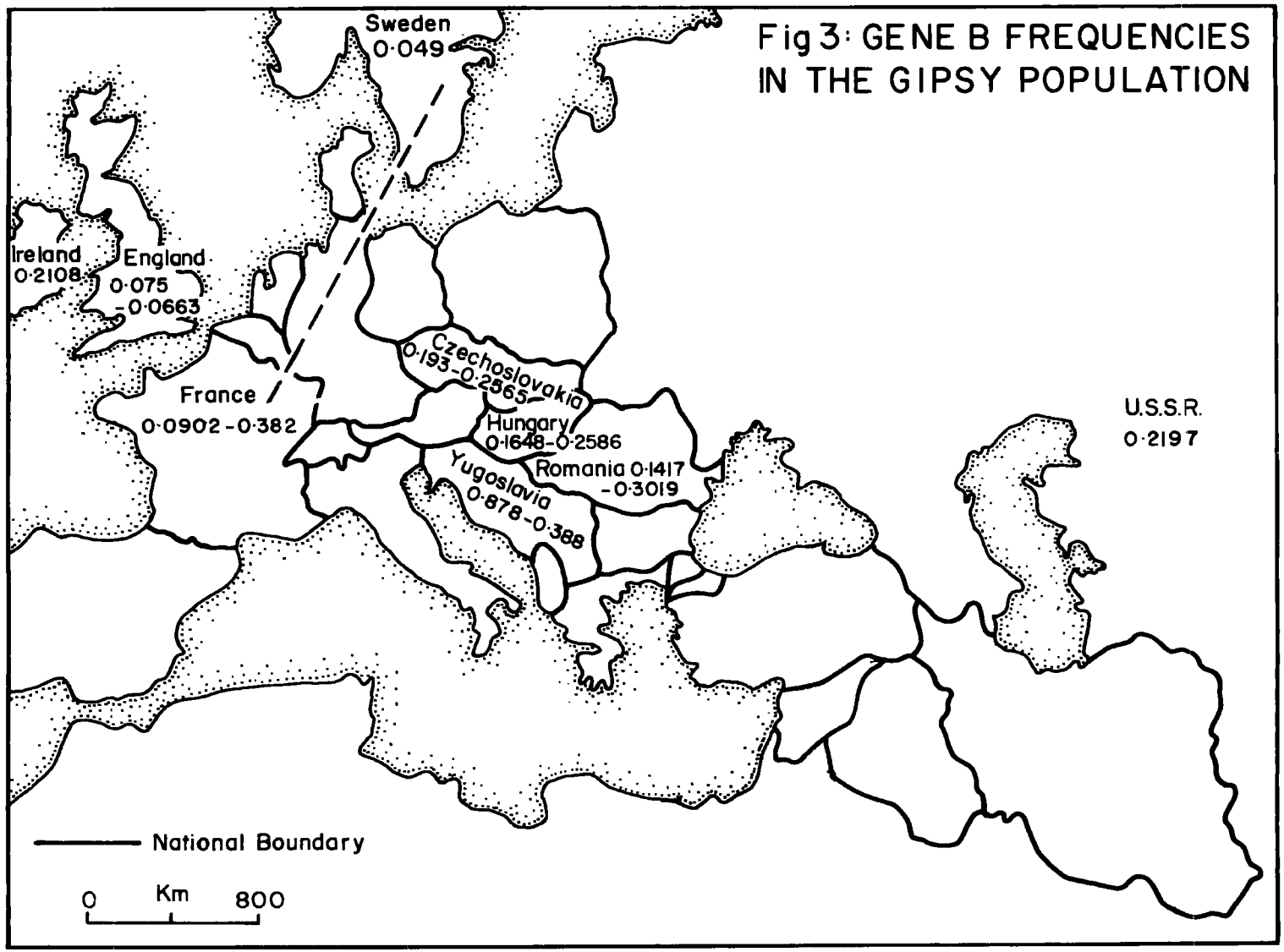


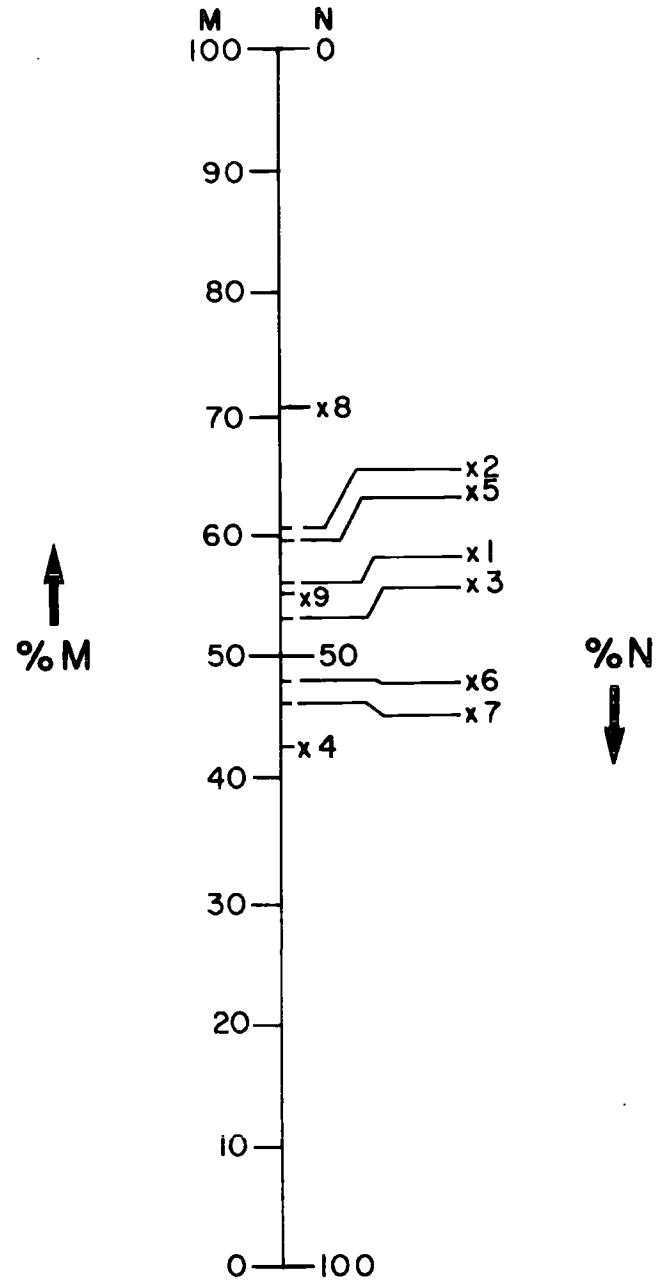
Fig 3: GENE B FREQUENCIES IN THE GIPSY POPULATION
Sweden 0·049
Ireland 0·2108
England 0·075 -0·0663
France 0·0902 - 0·382
Czechoslovakia 0·193 - 0·2565
Hungary 0·1648 - 0·2586
Romania 0·1417 - 0·3019
Yugoslavia 0·878 - 0·388
U.S.S.R. 0·2197
National Boundary
0 Km 800

Northern-Indian population values. The difference between the distributions of the ABO blood groups in the present study, Hungarian Gipsies (Rex-Kiss 1973), Romanian Gipsies (Hesch 1930), French Gipsies (Cazal 1951) and Russian Gipsies (Libman 1930) and the Northern-Indian population yield: x^2 = 1.15, 2.81, 1.24, 2.76 and 7.30, whereas the difference between the Yugoslavian Gipsies (Hocevar 1965), Swedish series (Beckman 1965), English Gipsies (Clarke 1973), Welsh series (Harper et al 1977) and the Northern Indian population are: x^2 = 40.72, 39.83, 26.7 and 18.6 respectively, this apparent anomaly has been explained by the effect of isolation and intermarriage between close blood relations (Winer 1943). Figure 2 illustrates the blood group distributions of the Gipsy populations and the Northern-Indian population and Figure 3 shows the distributions of the gene B (q) in the Gipsy populations in the relevant host countries. From Figure 3 it can be established that the B gene frequency in the North and West are lower than in Central and Eastern Europe. Chi-squared tests show no differences between the Swedish, English and Welsh Gipsy populations and the non-Gipsy populations of the host countries, (x^2 = 6.8, 6.6 and 4.4 respectively).

MN Blood Group Systems

In the Indian sub-continent a higher frequency of the M gene and a relatively low frequency of the N gene have been reported by several investigators. The frequency of the gene M in the population of the Northern-India, as in Asia generally, is higher than in Europe. Values between 0.60 and 0.70 are the most frequent. (Bird et al (1956), Papiha et al (1972)), compared with the European values 0.40, 0.50 (Mourant 1970). No differences were demonstrable in the distributions of the MN types and in the values of the gene frequencies between the present study, the Hungarian, Swedish, French and Welsh Gipsy populations

Fig.4



DISTRIBUTION OF 'M' AND 'N' GENE FREQENCIES IN SOME EUROPEAN GYPSIES

THE KEY

MN

1	Hungary (Rex-Kiss 1973)	6	Sweden (Beckman 1965)
2	Czechoslovakia (present study)	7	Wales (Harper et al 1977)
3	Czechoslovakia (Bernasovsky 1976)	8	England (Clarke 1973)
4	Slovenia (Hocvar 1969)	9	Ireland (Crawford 1971)
5	France (Cazal 1951)		

of Rex-Kiss (1973), Beckman et al (1965), Cazal (1951) and Harper et al (1977) respectively and the population of the North India, but significant differences were found between the Yugoslavian and English Gipsy populations of Hocevar (1965) and Clarke (1973) and the Northern Indian population. Figure 4 shows the distribution of the MN system in the Gipsy populations and in Northern India.

Rh Types

The striking similarity of the distribution of Rh types in the populations of India and Southern Europe is well known. Rh negative is generally under 10%.

The frequency of Rh negative type for the present study is 7.5%. Similarly, the Rh negative incidence has been reported as 8% among the Rajputs (North India) by S K Das (1978). The Yugoslavian Gipsies' value of 18.86% (Hocevar 1965, Avcini 1969) is much higher than the figure of 4.35% for the Swedish Gipsy population (Beckman, Tackman 1965) and 4.29% for the Welsh Gipsies of Harper, Sunderland, and Williams (1977).

The gene frequencies suggest that the gene d has frequencies within the range 0.207 and 0.434, except in Northern France (Ely 1961), where the value is low at 15.4%. Many of the Gipsies' results are within the European range of 30-45% and differ from the frequencies in the Indian which range from 10-30%. Only the present study (27.5%) the Czechoslovakian Gipsies of Bernasovsky et al (1975) with a value of 28.84%, Swedish Gipsies (20.9%) Beckman et al (1965), the small French sample of Ely (15.4) and the Welsh Gipsies of Harper et al (1977) with a value of (20.7%) approach the Indian range.

The chi-squared test shows no difference between the present sample, other Hungarian (Rex-Kiss 1973), Swedish (Beckman et al 1965), French (Cazal 1951), English (Clarke 1973) and Welsh (Harper et al 1977) Gipsy populations and the Northern Indian value, but significant difference between the Yugoslavian (Hocevar 1965) and Northern Indian groups ($P>0.02$).

The results of the Rh examinations made in Northern-India by Das et al (1978) exhibit a similarity in rr type as well as the frequencies of the Rh Chromosome of the present study to the Indian Populations. The distribution of the different Rh types shows a notable scattering due to the relatively small number of persons tested. In spite of that, however, there is a remarkable similarity in the high incidence of the Phenotype R1r, R1R1, of the Chromosome R1, and the low incidence of the Chromosome R2. The Czechoslovakian Gipsies with 15% less of the Chromosome r, 29% more of the R1 and 25% more of the R2 differ from the Czechoslovakian non-Gipsies studied by Kout (1959), Table (2). Slovenian Gipsies (Hocevar 1965) with a high Chromosome r and low of the R1 differ from the Indian population and differed only slightly from the surrounding population.

There are similarity in the Chromosome frequencies R1, R2 and r between the Hungarian, Swedish, French, English and Welsh Gipsy populations (Rex-Kiss et al 1973, Beckman et al 1965, Cazal 1951, Clarke 1973, and Harper, Sunderland and Williams 1977) and the North Indian population.

Kell Blood Group Systems

Tables 2.2I show the distributions of the Kell blood group systems. As can be seen from the tables the frequencies of the gene K are lower in India and in the Gipsy populations than in Europe. Not may data are available for comparison, but it is clear from the available data that the Kell positive Phenotype frequency is approximate 0.7% in Northern-

Indian populations. A high Phenotype frequency of the Kell positive (about 4.63%) was reported in the English Gipsy population (Clarke 1973). Relatively high frequencies of the gene k are found in European non-Gipsy populations; Czechoslovakia (0.05, England (0.046) and Wales (0.041), whereas in the present study it is 0.0168 and in the English series of Clarke (1973) 0.024, rather lower than the European's values.

Duffy Blood Group System - Tables 2-2

Generally speaking Asiatic populations are characterised by high Fya gene frequencies as compared with European populations (Mourant 1954).

Cutbush and Mollison (1950) tested 55 Asiatic Indians and found a Fya Phenotype frequency of 93%, a figure which may be due to the small sample size. But there is no doubt that a high frequency of the Fya gene is present in certain Indian populations. It appears that the incidence of the Fya antigen varies from 53-93% in different parts of India, Das et al (1967) and Papiha et al (1972).

Tables 2.2I show the distributions of the Duffy blood groups.

In the present study the samples were tested with anti Fya and anti Fyb serum. To the author's knowledge no other Gipsy populations or Northern-Indian populations have been tested for the complete Duffy system. The Fya Phenotype frequencies are 38.66% in the present study, 63.77% in the Welsh series of Harper, Sunderland and Williams (1977), and 59.43% in the English Gipsies of Clarke (1973) whereas it has been found to be 69.8% in the Welsh non-Gipsies of Ikin et al (1954) and 64.8% in the English series of Race et al (1968) and 62.67% in the Czechoslovakia series of Kout (1959) and 73.33% in the Northern-Indian population of Ikin et al (1954).

The gene frequencies in the Welsh, English and Irish Gipsy populations are lower than those in Northern-India and in the populations of England, Wales and Ireland, among whom they are living.

Serum Proteins

Tables 2.2I show the distributions of the haptoglobin and transferrin groups' Phenotypes and gene frequencies in some European Gipsy, European non-Gipsy and Northern-Indian populations for comparison.

Haptoglobin

World values for the HP1 gene range from 0.07 to 0.89 (Kirk 1961). The Indian sub-continent is an area of low HP1 values. In the Northern-Indian population the HP1 gene frequency has been found to range from 0.2094 - 0.237 (Papiha 1973).

The presence of Phenotype HP0-0 in North India has been reported by Blake et al (1971) and Kirk (1961). Most Gipsy populations studied including the present samples show HP1 gene frequencies less than 25% and lie within the range of 10-25% for the Indian Population and differ considerably from European non-Gipsy populations, the only exception being the English series of Clarke (1973). In the Hungarian Gipsies of Rex-Kiss (1973) a single subject showed the presence of the Phenotype HP0-0.

Transferrin

Tables 2.2I show the distributions of transferrin variants in four Gipsy populations, the populations of the host countries and Northern-India.

Variants of transferrin in some parts of India are rare. The TfcB is absent in the present study and in the Swedish Gipsy population of Beckman et al (1965) and the Northern Indian population of Das et al (1970). The frequency of Tf variants, other than type Tfcc, found in the Welsh Gipsies of Harper, Sunderland and Williams (1977) and the English series of Clarke (1973) are low (TfcB = 0.019 and 0.014 respectively) and are similar to the Welsh population of Tills (1971).

Few attempts have been made to study the distribution of Tf variants in North-India, Gipsy populations and relevant host countries.

Red Cell Isoenzymes

Tables 2.2I show the distributions of different isoenzymes systems.

Acid Phosphatase

Three alleles exist in many populations to control the Phenotypic expression of red cell acid phosphatase, and two of these, Pa and Pb are universally distributed. The third, Pc appears to be absent or of very low frequency in Negro populations (Hopkinson 1968). The polymorphic variant in India is controlled by three alleles, Pa, Pb and Pc, the third being very low as compared with the Pa and Pb genes. In the present study, the Pc allele occurred in six heterozygotes (three CA, three CB) and one homozygote (CC). The Pc gene frequency being 0.0039 in the North Indian population (Das et al 1970), whereas in the present study it is 0.0439 and 0.057 in the Czechoslovakian non-Gipsies (Herzog 1969). Most Indian populations lie within the range of Pa gene frequencies of 0.328 - 0.171. The present frequency of 0.307 is within this range.

Phosphoglucomutase

Data on the distribution of phosphoglucomutase on the two Gipsy populations (present study and Welsh Gipsies) and Northern-India populations are summarised in Tables 2.2I. The frequency of the PGM_1^1 gene among the Northern-Indian populations range from 0.6341 - 0.7937 (Blake et al 1971). The present frequency of 0.692 and the Welsh Gipsy population of Harper, Sunderland and Williams (1977) fit into the range of the Northern-Indian populations.

The PGM_1^2 frequencies range from 0.196 - 0.3537 in Northern-India, the present value of 0.3080 for the Slovakian Gipsies and 0.196 for the Welsh Gipsies lie therefore within the range.

Adenylate Kinase

Tables 2.2I show the distributions of the Adenylate Kinase (phenotype and gene frequencies) in the two series of Gipsy populations (present study and the Welsh Gipsies of Harper, Sunderland and Williams 1977) and for Northern-India. The AK2 gene frequency in the Indian populations is high, and in Northern-India range from 0.0563-0.127 (Blake et al 1970 and 1971). The present frequency of AK2 is slightly lower at 0.0252 and the Welsh series has zero. No other data are available for comparison.

Conclusion

The results obtained from the present study and other published data from the European Gipsy populations provide a basis for the establishment of a possible relationship between the European Gipsy populations and the population of North-India.

Most of the Gipsies' blood group systems which have been described in the previous chapters, show a striking similarity with those of the North Indian population. Regarding the ABO gene frequencies, some of the Gipsy populations exhibit a high B gene frequency which seems to be a characteristic feature of North Indian populations. However, some of them show low frequencies of the gene B (Swedish Gipsies, English Gipsies and Welsh Gipsies). Most Gipsy populations are small and probably have a high rate of consanguineous marriage and are isolated either geographically or socially from the surrounding population. It is clear that considerable heterogenity exists between the present day European Gipsy populations and that is due to admixture with host populations, genetic drift and the founder effect. The Hungarian and Czechoslovakian Gipsy populations who are extensive and widely distributed, have maintained high B gene frequencies and low HP1 gene frequencies and this supports the view of the genetic affinity of Gipsy populations and those of Northern-Indians, and it may be explained by the relatively great number of Gipsies in these countries where genetic drift cannot be observed.

TABLE 2 - Phenotypes of Czechoslovakian Gipsies and non-Gipsies and of Northern Indians

Blood Group System		Present Investigation		Slovak non-Gipsy		Northern Indians		
		N	%	N	%	N	%	
ABO	0	34	28.57	6949*	30.93*	38	30.64	Punjabis (Mathew 1959)
	A	31	26.05	9084*	40.43*	33	26.61	
	B	35	29.41	4424*	19.69*	39	31.45	
	AB	19	15.97	2011*	8.95*	14	11.29	
Total		119		22468		124		
MN	MM	37	31.042	434	28.16	29	29.0	Rajput (Das 1978)
	NN	10	8.403	282	18.30	16	16.0	
	MN	72	60.504	825	53.54	55	55.0	
Total		119		1541		100		
Rh	+(D)	110	92.44	19280	85.81	91	91.92	Rajput (Das 1978)
	-(d)	9	7.56	3188	14.19	8	8.08	
Total		119		22468		99		
HP	1-1	4	3.63	113+	17.07+	2	1.6	(Kirk 1961)
	2-1	30	27.28	316+	47.73+	32	25.6	
	2-2	76	69.09	233+	35.2+	90	72.0	
	0					1	0.8	
Total		110		662+		125	0.8	

* Smalik 1965
\+ Herzo 1961

TABLE 2 - Continued - Gene Frequencies of Czechoslovakian (Slovak) Gipsies and non-Gipsies and Northern Indians

Blood Group System		Gipsies Present Investigation	Slovak non-Gipsies	Northern Indians		
ABO	P	0.2345	0.2885*	ABO	0.2110	Punjabis (Mathew 1959)
	q	0.2565	0.1553*		0.2422	
	r	0.5089	0.5561*		0.5467	
MN	m	0.6135	0.5493		0.565	Rajput (Das 1978)
	n	0.3865	0.4507		0.435	
Rh	D	0.7250	0.6223		0.719	Rajput (Das 1978)
	d	0.2750	0.3767		0.281	
HP	1-1	0.1727	0.4094+		0.15	(Kirk 1961)
	2-2	0.8273	0.5906+		0.85	

* Smalik (1965)
\+ Herzo (1963)

TABLE 2 - Continued - Czechoslovakian Gipsies and non-Gipsies and Northern Indians

Blood Group System		Present Investigation		Czechoslovakian non-Gipsies		Northern Indians		
		N	%	N	%	N	%	
Trans-ferrin	Tfc	59	100			424	100	)Bihar
	TfB	0	0			0	0	)(Das 1970)
Total		59				424		
Duffy	Fya	46	38.66	376*	62.67*	55	73.33	)Panjabi
	Fyb	38	31.93	224*	37.33*	20	26.67	)(Das 1970)
	Fya,b	35	29.41	-		-		
Total		119		600		75		
Kell	K+K+	0	0	41*	9.81*	1	0.7	)
	K-k-	115	96.64	377*	90.19*	136	99.3	)(Papiha 1972)
	K+K-	4	3.36					
Total		119		418		137		
AP	A	9	9.89	49+	15.97+	24	9.34	)
	AB	35	38.46	116+	37.79+	89	34.63	)
	B	40	43.96	107+	34.85+	142	55.25	)(Das 1970)
	CA	3	3.30	10+	3.26+	2	0.78	)
	CB	3	3.30	25+	8.14+	0		
	C	1	1.09	0		0		
Total		91		307		257		

* Praha (Kout 1959)
\+ Praha (Herzog 1961)

TABLE 2 - Continued - Gene Frequencies of the Czechoslovakian (Slovak) Gipsies and non-Gipsies and Northern Indians

Blood Group System		Present Investigation	Czechoslovakia non-Gipsies	Northern Indians
Transferrin	Tfc	1		1 } Bihar (Das 1970)
	Tfb	0.00		0.00 }
Duffy	Fya	0.5336	0.5165	0.4836 } Panjabi (Das 1970)
	Fyb	0.4664	0.4835	0.5164 }
Kell	K+	0.0168	0.0503*	0.004 } (Papiha 1972)
	K-	0.9832	0.9497*	0.996 }
AP	PA	0.3077	0.3648+	0.2704 } (Das 1970)
	PB	0.6484	0.5782+	0.7257 }
	PC	0.0439	0.0570+	0.0039 }

* Praha (Kout 1959)
\+ Praha (Herzog 1969)

TABLE 2 - Continued - Czechoslovakian Gipsies and non-Gipsies and Northern Indians

Blood Group System		Present Investigation		Czechoslovakia non-Gipsies	Northern Indians (West Bengal, Das et al 1970)	
		N	%		N	%
AK	1-1	113	94.96	-	226	83.4
	2-1	6	5.04	-	43	15.86
	2-2	0	0	-	2	0.74
Total		119			271	
PGM	1-1	58	51.79	-	140	52.04
	2-1	39	34.82	-	95	35.31
	2-2	15	13.39	-	33	12.27
rare variant	6-1				1	0.38
Total		112			269	

TABLE 2 - Continued - Gene Frequencies of the Czechoslovakian (Slovak) Gipsies and non-Gipsies and Northern-Indians

Blood Group System		Present Investigation	Czechoslovakia non-Gipsies (Calikova 1975)	Northern Indians
AK	AK1	0.9748	0.9773	0.9133
	AK2	0.0252	0.0227	0.0867
			Total N = 220	
PGM	PGM_1^1	0.692	0.7675	0.6989
	PGM_1^2	0.308	0.2325	0.2993
			Total N = 258	

TABLE 2 - Rh Blood Group Phenotype on Czechoslovakian Gipsy Population, non-Gipsies and Northern Indians

Blood Group System		Gipsy Present Study		non-Gipsy Kout 1959		Northern Indians Das 1978	
Rh	rr	9	% 7.56	91	% 15.17	6	% 6.06
	R1r	37	31.09	215	35.83	-	
	R1R1	64	53.79	123	20.50	76	76.77
	R0r	-		16	2.67	8	8.08
	R2r	-		-		-	
	R2R2	-		73	12.17	2	2.02
	r′r′	-		-		2	2.02
	r′r	-		3	0.5	-	
	R2R1	9	7.56	76	12.67	-	
	r″r′	-		1	0.17	-	
	RzR1	-		2	0.3	5	5.05
	Total	119		600		99	

TABLE 2 - Chromosome Frequencies of the Czechoslovakian Gipsy and non-Gipsies and Northern Indians

Blood Group System		Gipsies Present Study	non-Gipsies Kout 1959	Northern-Indians Das 1978
Rh	r	0.2311	0.3823	0.242
	r′	0.00	0.0066	0.039
	r″	0.00	0.0022	0.00
	Ry	0.00	0.00	0.00
	R0	0.00	0.0322	0.00
	R1	0.7311	0.4432	0.556
	R2	0.0378	0.1297	0.036
	Rz	0.00	0.0038	0.00

TABLE 2.A - Published Data of Hungarian Gipsies and non-Gipsies and of Northern Indians for Comparison

Blood Group Types		Hungarian Gipsies		Hungarian non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Rex-Kiss 1973		Rex-Kiss 1971		Mathew 1959	
ABO	0	162	27.0	15775	31.51	38	30.64
	A	206	34.3	20960	41.92	33	26.61
	B	168	28.0	9115	18.23	39	31.45
	AB	64	10.7	4170	8.34	14	11.29
Total		600		50000		124	
		Rex-Kiss 1973		Rex-Kiss 1971		Das 1978	
MN	MM	166	31.0	6520	32.60	29	29.0
	MN	267	49.8	9800	49.0	55	55.0
	NN	103	19.2	3680	18.40	16	16.0
Total		536		20000		100	
		Rex-Kiss 1973		Rex-Kiss 1971		Das 1978	
Rh	D+	455	89.74	4184	83.68	91	91.92
	D-	52	10.26	816	16.32	8	8.08
Total		507		5000		99	
		Rex-Kiss 1973		Rex-Kiss 1971		Kirk 1961	
HP	1-1	30	5.8	575	11.50	2	1.6
	2-1	152	29.2	2215	44.30	32	25.6
	2-2	336	64.6	2210	44.20	90	72.0
	0-0	2	0.4			1	0.8
Total		520		5000		125	

TABLE 2.A - Continued - Rh Blood Group Phenotype on the Hungarian Gipsy Population compared with that of the non-Gipsies and Northern Indians

Blood Group System		Gipsies Rex-Kiss 1973		Non-Gipsies Rex-Kiss 1962 *		Northern-Indians Das 1978	
Rh	rr	49	% 9.7	310	% 15.5	6	% 6.06
	R1r	190	37.5	688	34.4	-	
	R1R1	202	39.9	360	18	76	76.77
	R0r	2	0.4	40	2	8	8.08
	R2r	18	3.5		1	-	
	R2R2	-		320	16	2	2.02
	r′r′	-		-		2	2.02
	r r′	3	0.6	50	2.5	-	
	R2R1	43	8.5	210	10.5	-	
	r″r′	-		-		-	
	RzR1	-		2	0.1	5	5.05
	r″r			20	1		
Total		507		2000		99	

* Quoted by Mourant

TABLE 2.A - Continued - Gene Frequencies of the Hungarian Gipsies and those of the non-Gipsies and Northern Indians

Blood Group Types		Gipsies	Non-Gipsies	Northern Indians
ABO	P	0.2635	0.2946	0.2110
	q	0.2169	0.1429	0.2422
	r	0.5196	0.5625	0.5467
MN	m	0.5588	0.5710	0.5650
	n	0.4412	0.4290	0.4350
Rh	D+	0.6800	0.5960	0.7190
	D-	0.3200	0.4040	0.2810
HP	HP1	0.2040	0.3365	0.1500
	HP2	0.7960	0.6635	0.8500

TABLE 2.A - Continued - Chromosome Frequencies of the Hungarian Gipsies and non-Gipsies and Northern Indians

Blood Group System		Gipsies Rex-Kiss 1973	Non-Gipsies Rex-Kiss 1962	Northern Indians Das 1978
Rh	r	0.3108	0.4068	0.242
	r′	0.0095	0.0277	0.039
	r″	0.0	0.0103	0.0
	Ry	0.0	0.0	0.0
	R0	0.0063	0.0253	0.0
	R1	0.6039	0.3895	0.556
	R2	0.052	0.1394	0.036
	Rz	0.0022	0.001	0.0

TABLE 2.B - Published Data of Yugoslavian Gipsies (Phenotypes) and non-Gipsies and of Northern Indians

Blood Group Types		Gipsies		Non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Hocevar 1965 Avcin 1969		Quoted by Avcin 1969		Mathew 1959	
ABO	0	120	34.28	393	36.97	38	30.64
	A	173	49.42	406	38.20	33	26.61
	B	36	10.28	186	17.50	39	31.45
	AB	21	5.99	78	7.33	14	11.29
Total		350		1063		124	
		Hocevar 1965 Avcin 1969		Quoted by Avcin 1969		Das 1978	
MN	MM	67	19.14	304	30.40	29	29.0
	MN	164	46.86	543	54.30	55	55.0
	NN	119	34.0	153	15.30	16	16.0
Total		350		1000		100	
		Hocevar 1965 Avcin 1969		Quoted by Avcin 1969		Das 1978	
Rh	D+	284	81.14	222	81.02	91	91.92
	D-	66	18.86	52	18.98	8	8.08
Total		350		274		99	
		Fraser 1969		Fraser 1969		Kirk 1961	
HP	1-1	2	5.26	9	10.11	2	1.6
	2-1	9	23.69	38	42.69	32	25.6
	2-2	27	71.05	41	46.67	90	72.0
	0-0			1	1.12	1	0.8
Total		38		89		125	

TABLE 2.B - Continued - Rh Blood Group Phenotypes on the Yugoslavian (Slovenia) Gipsies and non-Gipsies and of Northern-Indians for Comparison

Blood Group System		Gipsies Hocevar 1965		non-Gipsies Hocevar 1964		Northern-Indians Das 1978	
Rh	rr	50	% 14.28	15	% 11.2	6	% 6.06
	R1r	130	37.13	51	38.38	-	
	R1R1	85	24.38	28	21.04	76	76.77
	Ror	-		2	1.50	8	8.08
	R2r	20	5.71	14	10.52	-	
	R2R2	6	1.70	4	3.0	2	2.02
	r′r′	2	0.57	-		2	2.02
	rr′	14	4.0	2	1.50	-	
	R2R1	42	12.0	17	12.79	-	
	r″r′	-		-		-	
	RzR1	1	0.28	-		5	5.05
Total		350		133		99	

TABLE 2.B - Continued - Gene Frequencies of the Yugoslavian Gipsies and non-Gipsies and Northern-Indians

Blood Group Types		Gipsies	Non-Gipsies	Northern Indians
ABO	P	0.3300	0.2616	0.2110
	q	0.0878	0.1328	0.2422
	r	0.5822	0.6056	0.5467
MN	m	0.4257	0.5755	0.5650
	n	0.5743	0.4245	0.4350
Rh	D	0.5660	0.5687	0.7190
	d	0.4340	0.4313	0.2810
HP	HP1	0.1710	0.3180	0.1500
	HP2	0.8290	0.6820	0.8500

TABLE 2.B - Continued - Chromosome Frequencies of the Slovenian (Yugoslavian) Gipsies and non-Gipsies and Northern Indians

Blood Group System		Gipsies Hocevar 1965	Non-Gipsies Hocevar 1964	Northern Indians Das 1978
Rh	r	0.3768	0.3564	0.242
	r′	0.0564	0.0183	0.039
	r″	0.0	0.0	0.0
	Ry	0.0	0.0	0.0
	R0	0.0	0.0229	0.0
	R1	0.4431	0.4557	0.556
	R2	0.1209	0.1467	0.036
	Rz	0.0028	0.0	0.0

TABLE 2.C - Published Date of (Phenotypes) of Romanion Gipsies and non-Gipsies and Northern Indians for Comparison

Blood Group Types		Gipsies		Non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Hesch 1930		Bilba 1969*		Mathew 1959	
ABO	0	27	26.47	100	27.32	38	30.64
	A	28	27.25	164	44.81	33	26.61
	B	38	37.25	72	19.67	39	31.45
	AB	9	8.82	30	8.2	14	11.29
Total		102		366		124	

Gene Frequencies of Romanian Gipsies and non-Gipsies and Northern Indians

Blood Group Types		Gipsies	Non-Gipsies	Northern Indians
ABO	P	0.2036	0.3164	0.2110
	q	0.2681	0.1516	0.2422
	r	0.5283	0.5320	0.5467

* Quoted by Mourant

TABLE 2.D - Published Data of (Phenotypes) of Swedish Gipsies, and non-Gipsies and Northern Indians

Blood Group Types		Gipsies		Non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Beckman Tackman 1965		Beckman 1959		Mathew 1959	
ABO	0	36	31.3	3974	38.0	38	30.64
	A	68	59.1	4939	47.23	33	26.61
	B	7	6.1	1040	9.95	39	31.45
	AB	4	3.5	504	4.82	14	11.29
Total		115		10457		124	
		Beckman Tackman 1965		Beckman 1959		Das 1978	
MN	MM	23	20.2	3370	32.23	29	29.0
	MN	64	55.7	5178	49.52	55	55.0
	NN	28	24.3	1909	18.26	16	16.0
Total		115		10457		100	
		Beckman Tackman 1965		Beckman 1959		Das 1978	
Rh	D+	110	95.65	7152	84.26	91	91.92
	D-	5	4.35	1336	15.74	8	8.08
Total		115		8488		99	
		Beckman Tackman 1965		Beckman 1961		Kirk 1961	
HP	1-1	0	0	193	15.2	2	1.6
	2-1	27	23.5	615	48.3	32	25.6
	2-2	88	76.5	464	36.5	90	72.0
						1	0.8
Total		115		1272		125	

TABLE 2.D - Continued - Rh Blood Group Phenotypes on the Swedish Gipsy and non-Gipsy population and on Northern Indians

Blood Group System		Gipsies Beckman et al 1965		Non-Gipsies Smars et al 1961		Northern Indians Das 1978	
Rh	rr	4	% 3.48	36	% 16	6	% 6.06
	R1r	-		70	31	-	
	R1R1	88	76.52	40	17.8	76	76.77
	R0r	-		6	2.7	8	8.08
	R2r	-		28	12.4	-	
	R2R2	7	6.09	6	2.7	2	2.02
	r′r′	1	0.87	-		2	2.02
	rr′	-		3	1.3	-	
	R2R1	-		32	14.2	-	
	r″r′	-		-		-	
	RzR1	15	13.04			5	5.05
	r″r			4	1.8		
Total		115		225		99	

TABLE 2.D - Continued - Gene Frequencies of the Swedish Gipsies and non-Gipsies and Northern Indians

Blood Group Types		Gipsies	Non-Gipsies	Northern Indians
		Beckman Tackman 1965	Beckman 1959	Mathew 1959
ABO	P	0.3890	0.3075	0.2110
	q	0.0490	0.0767	0.2422
	r	0.5620	0.6158	0.5467
		Beckman Tackman 1965	Beckman 1959	Das 1978
MN	m	0.4780	0.5699	0.5650
	n	0.5220	0.4302	0.4350
		Beckman Tackman 1965	Beckman 1959	Das 1978
Rh	D	0.7910	0.6040	0.7190
	d	0.2090	0.3960	0.2810
		Beckman Tackman 1965	Beckman 1961	Kirk 1961
HP	HP1	0.1170	0.3935	0.1500
	HP2	0.8830	0.6065	0.8500

TABLE 2.D - Continued - Chromosome Frequencies of the Swedish Gipsies and non-Gipsies and Northern Indians

Blood Group System		Gipsies - Beckman et al 1965	non-Gipsies Smars 1961 *	Northern Indians Das 1978
Rh	r	0.1997	0.3886	0.242
	r′	0.0205	0.0116	0.039
	r″	0.0	0.0211	0.0
	Ry	0.0	-	0.0
	R0	0.0	0.0309	0.0
	R1	0.6779	0.3949	0.556
	R2	0.1019	0.1479	0.036
	Rz	0.0	0.0	0.0

*Quoted by Mourant

TABLE 2.E - Published Data of French Gipsies, non-Gipsies and Northern-Indians for Comparison

Blood Group Types		Gipsies		Non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Cazal 1951		Nicoli 1965		Mathew 1959	
ABO	O	25	22.1	64	39.75	38	30.64
	A	29	25.7	77	47.82	33	26.61
	B	43	38.1	14	8.7	39	31.45
	AB	16	14.1	6	3.73	14	11.29
Total		113		161		124	
		Cazal 1951		Kherumian 1967*		Das 1978	
MN	MM	31	36.05	355	32.84	29	29.0
	MN	40	46.51	518	47.92	55	55.0
	NN	15	17.44	208	19.24	16	16.0
Total		86		1081		100	
		Cazal 1951		Hubinont 1952*		Das 1978	
Rh	D+	91	85.05	235	78.33	91	91.92
	D-	16	14.95	65	21.67	8	8.08
Total		107		300		99	

* Quoted by Mourant

TABLE 2.E - Continued - Rh Blood Group Phenotype on French Gipsy and non-Gipsy populations and Northern Indians

Blood Group System		Gipsies Cazal 1951		non-Gipsies Derycke 1965		Northern Indians Das 1978	
Rh	rr	14	% 13.08	81	% 16.2	6	% 6.06
	R1r	30	28.04	182	36.4	-	
	R1R1	52	48.60	94	18.8	76	76.77
	ROr	4	3.74	30	6.0	8	8.08
	R2r	-		54	10.8	-	
	R2R2	1	0.93	12	2.4	2	2.02
	r'r'	-				2	2.02
	rr'	2	1.87	1	0.2	-	
	R2R1	4	3.74	42	8.4	-	
	r''r'			3	0.6		
	RzR1					5	5.05
	r''r			1	0.2		
Total		107		500		99	

TABLE 2.E - Continued - Gene Frequencies of the French Gipsies and non-Gipsies and Northern Indians

Blood Group Types		Gipsies	Non-Gipsies	Northern Indians
		Cazal 1951	Nicoli 1965	Mathew 1959
ABO	P	0.2310	0.3042	0.2110
	q	0.3140	0.0642	0.2422
	r	0.4590	0.6316	0.5467
		Cazal 1951	Kherumian 1967	Das 1978
MN	m	0.5930	0.5680	0.5650
	n	0.4070	0.4320	0.4350
		Cazal 1951	Hubinant 1952	Das 1978
Rh	D	0.6130	0.5494	0.7190
	d	0.3870	0.4506	0.2810

TABLE 2.E-Continued - Chromosome Frequencies of the French Gipsy and non-Gipsy population and Northern Indians

Blood Group System		Gipsies Cazal 1951	non-Gipsies Derycke 1965*	Northern Indians Das 1978
Rh	r	0.2841	0.3949	0.242
	r′	0.0329	0.0026	0.039
	r″	0.0	0.0073	0.0
	Ry	0.0	0.0	0.0
	R0	0.038	0.0674	0.0
	R1	0.6213	0.4101	0.556
	R2	0.0236	0.1161	0.036
	Rz	0.0	0.0016	0.0

*Quoted by Mourant

TABLE 2.F - Published Data of (Phenotypes) of English Gipsies and non-Gipsies and of Northern Indians

Blood Group Types		Gipsies		Non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Clarke 1973		Kopec 1970*		Mathew 1959	
ABO	O	43	39.45	120	51.95	38	30.64
	A	52	47.71	77	33.33	33	26.61
	B	9	8.26	23	9.96	39	31.45
	AB	5	4.58	11	4.76	14	11.29
Total		109		231		124	
		Clarke 1973		Taylor and Prior 1938*		Das 1978	
MN	MM	54	49.54	121	28.68	29	29.0
	MN	45	41.29	200	47.39	55	55.0
	NN	10	9.17	101	23.93	16	16.0
Total		109		422		100	
		Clarke 1973		Race et al 1968		Das 1970	
Fy	Fya	63	59.43	162	64.8	55	73.33
	Fyb	43	40.57	88	32.2	20	26.67
Total		106		250		75	
		Clarke 1973		Cleghorn 1961*		Papiha 1972	
Kell	K+	5	4.63	792	9.03	1	0.7
	K+K-	0		0		0	
	K-	103	95.37	7975	90.97	136	99.3
Total		108		8767		137	

* Quoted by Mourant

TABLE 2.F - Continued - Gene Frequencies of the English Gipsies and non-Gipsies and Northern Indians

Blood Group Types		Gipsies	non-Gipsies	Northern Indians
		Clarke 1973	Kopec 1970	Mathew 1959
ABO	P	0.309	0.2121	0.211
	q	0.066	0.0761	0.2422
	r	0.626	0.7118	0.5467
		Clarke 1973	Taylor et al 1938	Das 1978
MN	m	0.702	0.5237	0.565
	n	0.298	0.4763	0.435
		Clarke 1973	Race et al 1968	Das 1970
Fy	Fya	0.362	0.4067	0.4836
	Fyb	0.638	0.5933	0.5164
		Clarke 1973	Cleghorn 1961	Papiha 1972
K	K+	0.024	0.0462	0.004
	K-	0.976	0.9538	0.996

TABLE 2.F - Continued - Published Data of (Phenotypes) of English Gipsies and non-Gipsies and of the Northern Indians

Blood Group Types		Gipsies		Non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Clarke 1973		Kopéc 1970		Das 1978	
Rh	D+	93	85.22	73	71.57	91	91.92
	D-	16	14.68	29	28.43	8	8.08
Total		109		102		99	
		Clarke 1973		Harris et al 1959		Kirk 1961	
HP	1-1	16	15.53	33	18.44	2	1.6
	2-1	54	52.43	88	49.16	32	25.6
	2-2	33	32.04	58	32.40	90	72.0
	0-0	0	0	0	0	1	0.8
Total		103		179		125	
		Clarke 1973				Das 1970	
Tf	Tfc	100	97.09			424	100
	TfB	3	2.91			0	0
Total		103				424	

TABLE 2.F - Continued - Rh Blood Group Phenotype on English Gipsy and non-Gipsies and Northern Indians for Comparison

Blood Group System		Gipsies Clarke 1973		non-Gipsies Race et al 1944 *		Northern Indians Das 1978	
Rh	rr	14	% 12.84	21	% 13.64	6	% 6.06
	R1r	34	31.2	55	35.71	-	
	R1R1	28	25.7	26	16.88	76	76.77
	ROr	-		1	0.65	8	8.08
	R2r	-		-		-	
	R2R2	11	10.1	28	18.18	2	2.02
	r′r′	-		-		2	2.02
	rr′	1	0.91	1	0.65	-	
	R2R1	19	17.43	-			
	r″r′	-		2	1.29		
	RzR1	-		-		5	5.05
	r″r	1	0.91	20	12.98		
	RzRz	1	0.91				
Total		109		154		99	

* Quoted by Mourant

TABLE 2.F - Continued - Gene Frequencies of the English Gipsies and non-Gipsies and Northern Indians

Blood Group Systems		Gipsies	Non-Gipsies	Northern Indians
		Clarke 1973	Kopéc 1970	Das 1978
Rh	D	0.617	0.467	0.716
	d	0.383	0.533	0.284
		Clarke 1973	Harris et al 1969	Kirk 1961
HP	HP1	0.417	0.4302	0.15
	HP2	0.583	0.5998	0.85
		Clarke 1973		Das 1970
Tf	C	0.986		1
	B	0.014		0.00

TABLE 2.F - Continued - Chromosome Frequencies of the English Gipsy and non-Gipsy and Northern Indians

Blood Group Style		Gipsies Clarke 1973	non-Gipsies Race et al 1944	Northern Indians Das 1978
Rh	r	0.2936	0.3949	0.242
	r′	0.0128	0.0073	0.039
	r″	0.0211	0.0146	0.0
	Ry	0.0046	-	0.0
	R0	0.0	0.0093	0.0
	R1	0.4918	0.4084	0.556
	R2	0.1761	0.1655	0.036
	Rz	0.0	-	0.0

TABLE 2.G - Published Data of Phenotypes of Welsh Gipsies, non-Gipsies and of Northern Indians

Blood Group Types		Gipsies		Non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Harper et al 1977		Watkin 1960*		Mathew 1959	
ABO	O	30	42.86	407	46.35	38	30.64
	A	30	42.86	340	38.72	33	26.21
	B	10	14.28	92	10.48	39	31.45
	AB	0	0	39	4.45	14	11.29
Total		70		878		124	
		Harper et al 1977		Boyd and Boyd 1937		Das 1978	
MN	MM	16	22.85	59	30.73	29	29.0
	MN	33	47.15	106	55.21	55	55.0
	NN	21	30.0	27	14.06	16	16.0
Total		70		192		100	
		Harper et al 1977		Ikin et al 1954*		Das 1970	
Fy	Fya	44	63.77	81	69.8	55	73.33
	Fyb	25	36.23	35	30.2	20	26.67
Total		69		116		75	
		Harper et al 1977		Drummond 1969*		Papiha 1972	
Kell	K+	0	0	58	8.20	1	0.7
	K+K-	0	0	0	0		
	K-	70	100	649	91.80	136	99.3
Total		70		707		137	

* Quoted by Mourant

TABLE 2.G - Continued - Published Data of Phenotypes of Welsh Gipsies non-Gipsies and of Northern Indians

Blood Group Types		Gipsies		non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Harper et al 1977		Kopec 1970		Das 1978	
Rh	D+	67	95.71	12927	83.49	91	91.92
	D-	3	4.29	2557	16.51	8	8.08
Total		70		15484		99	
		Harper et al 1977		Tills 1971		Kirk 1961	
HP	1-1	3	3.95	60	19.04	2	1.6
	2-1	30	39.47	138	43.81	32	25.6
	2-2	43	56.58	117	37.5	90	72.0
	0	0	0	0	0	1	0.8
Total		76		315		125	
		Harper et al 1977		Tills 1971		Das 1970	
Tf	C	74	96.1	310	97.48	424	100.0
	BC	3	3.9	8	2.52	0	0
Total		77		318		424	

TABLE 2.G - Continued - Rh Blood Group Phenotype of Welsh Gipsies, non-Gipsies and of Northern Indians

Blood Group System		Gipsies Harper et al 1977		non-Gipsies Garlick et al 1957*		Northern Indians Das 1978	
Rh	rr	2	% 2.86	57	% 13.51	6	% 6.06
	R1r	17	24.28	130	30.80	-	
	R1R1	23	32.86	77	18.25	76	76.77
	ROr	-		12	2.84	8	8.08
	R2r	9	12.86			-	
	R2R2	6	8.57	77	18.25	2	2.02
	r′r′	-				2	2.02
	r′r	-		1	0.24	-	
	R2R1	12	17.14	64	15.16	-	
	r″r′	1	1.43			-	
	RzR1					5	5.05
	r″r			2	0.47		
	ccDUE			2	0.47		
Total		70		422 Tested also for DU		99	

* Quoted by Mourant

TABLE 2.G - Continued - Gene frequencies of the Welsh Gipsies non-Gipsies and Northern Indians

Blood Group Types		Gipsies	Non-Gipsies	Northern Indians
		Harper et al 1977	Watkin 1960*	Mathew 1959
ABO	P	0.248	0.2449	0.2110
	q	0.075	0.0765	0.2422
	r	0.676	0.6786	0.5467
		Harper et al 1977	Boyd and Boyd 1937	Das 1978
MN	m	0.464	0.5833	0.5650
	n	0.536	0.4167	0.4350
		Harper et al 1977	Ikin et al 1954	Das 1970
Fy	Fya	0.398	0.4507	0.4836
	Fyb	0.602	0.5493	0.5164
		Harper et al 1977	Drummond 1969*	Papiha 1972
Kell	K+	0	0.0419	0.004
	K-	1	0.9581	0.996
		Harper et al 1977	Kopeć 1970	Das 1978
Rh	D	0.793	0.5937	0.7190
	d	0.207	0.4063	0.2810
		Harper et al 1977	Tills 1971	Kirk 1961
HP	HP1	0.237	0.4095	0.15
	HP2	0.763	0.5905	0.85
		Harper et al 1977	Tills 1971	Das 1970
Tf	C	0.981	0.9874	1
	B	0.019	0.0126	0.00

*Quoted by Mourant

TABLE 2.G - Continued - Chromosome Frequencies of the Welsh Gipsies, non Gipsies and Northern Indians

Blood Group System		Gipsies Harper et al 1977	non-Gipsies Carlick, 1957 et al	Northern Indians Das 1978
Rh	r	0.2214	0.3599	0.242
	$r^{'}$	0.0	0.0033	0.039
	$r^{''}$	0.0308	0.0063	0.0
	Ry	0.0	0.0	0.0
	R0	0.0	0.0361	0.0
	R1	0.5357	0.4103	0.556
	R2	0.2121	0.1779	0.036
	Rz	0.0	0.0	0.0
	cDUE		0.0062	

TABLE 2.G - Continued - Published Data of Phenotypes of Welsh Gipsies non-Gipsies and of Northern Indians

Blood Group Types		Gipsies		Non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Harper et al 1977		NO DATA		Das et al 1970	
PGM	1-1	45	65.22			140	52.04
	2-1	21	30.43			95	35.31
	2-2	3	4.35			33	12.27
rare variant	6-1					1	0.38
Total		69				269	
		Harper et al 1977				Das et al 1970	
AK	1-1	71	100			226	83.4
	2-1	0	0			43	15.86
	2-2	0	0			2	0.74
Total		71				271	
		Harper et al 1977				Das et al 1970	
AP	A	12	18.75			24	9.34
	AB	19	29.69			89	34.63
	B	28	43.75			142	55.25
	CA	-	-			2	0.78
	CB	5	7.81			-	-
	C	-	-			-	-
Total		64				257	

TABLE 2.G - Continued - Gene Frequencies of the Welsh Gipsies non-Gipsies and Northern Indians

Blood Group Types		Gipsies	non-Gipsies	Northern Indians
PGM	PGM^1_1	0.805	NO DATA	0.6989
	PGM^2_1	0.196		0.2993
AK	AK1	1		0.9133
	AK2	0.00		0.0867
AP	PA	0.3077		0.2704
	PB	0.6484		0.7257
	PC	0.0439		0.0039

TABLE 2.H - Gene Frequencies of the Irish Tinkers and non-Tinkers and Northern Indians

Blood Group Types		Tinkers	non-Tinkers	Northern Indians
		Crawford 1971	Casey et al 1962	
ABO	P	0.2010	0.1811	0.2110
	q	0.1208	0.0664	0.2422
	r	0.6859	0.7525	0.5467
Total	119		4514	
		Crawford 1971	Casey et al 1962	
MN	m	0.5466	0.5493	0.565
	n	0.4533	0.4507	0.435
Total	119		304	
		Crawford 1971	Likin et al 1954	
Fy	Fya	0.3519	0.4092	0.4836
	Fyb	0.6481	0.5908	0.5164
Total	119		106	

TABLE 2.I - Published Data of Phenotypes of Russian Gipsies and Russian non-Gipsies and of the Northern Indians

Blood Group Types		Gipsies		non-Gipsies		Northern Indians	
		N	%	N	%	N	%
		Libman 1930		Libman 1930 (Uzbekistan)		Mathew 1959	
ABO	A	44	42.31	43	21.94	33	26.61
	B	30	28.85	74	37.76	39	31.45
	0	20	19.23	58	29.59	38	30.64
	AB	10	9.61	21	10.71	14	11.29
Total		104		196		124	

Gene frequencies of the Russian Gipsies and those of the Russian non-Gipsies and Northern Indians

Blood Group Types		Gipsies	non-Gipsies	Northern Indians
		Libman 1930	Libman 1930	Mathew 1959
ABO	P	0.3126	0.1788	0.2110
	q	0.2197	0.2814	0.2422
	r	0.4677	0.5398	0.5467

SUMMARY

Blood and Serum groups have been studied in a Slovakian Gipsy Population.

1. In the ABO blood group; there are no significant differences between the present study and some of the Czechoslovakian, Hungarian, Romanian, Yugoslavian and French Gipsy populations.

2. MN System; significant differences can be detected between present samples and each of the other Gipsy populations.

3. Rh system; no significant differences evident between the Gipsy populations. The only exception being the Yugoslavian series.

4. HP types; A low frequency of phenotype HP1-1 was observed in Gipsy populations, except for the English series.

5. ESD; there were significant differences between the Gipsy populations.

6. AP; a high Pc gene frquency were found in the present study and Welsh Gipsies.

7. PGM and AK; no differences were detected between the available data and the Slovakian Gipsy populations.

Swedish, Welsh, Yugoslavian and French Gipsy populations are represent isolated populations where the gene frequencies to a large extent may have been determined by genetic drift and founder effect.

A comparison of the Slovakian Gipsy population with those of the Northern-Indian population and those of the Slovakian non-Gipsies showed that the gene frequency values of the Czechoslovakian Gipsies are similar to the Northern-Indians, and differed from the Slovakian population.

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